

# **SPECIFICATIONS FOR CONSTRUCTION CONTRACT SOLICITATION: DACA45-03-B-0005**

## **HQ NORTHCOM BEDDOWN/NORAD CONTINGENCY OPERATIONS (NORAD BMC) & AT/FP IMPROVEMENTS**



**PETERSON AFB, COLORADO**

**Volume 2 of 3  
Divisions 03-14**

**AUGUST 2003**



**U.S. Army Corps of Engineers,  
Omaha District**

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**HQ NORTHCOM BEDDOWN/NORAD  
CONTINGENCY OPERATIONS (NORAD BMC) & AT/FP  
IMPROVEMENTS  
AT  
PETERSON AFB, COLORADO**

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**05/98**

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## SECTION 03100

STRUCTURAL CONCRETE FORMWORK  
05/98

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## ACI INTERNATIONAL (ACI)

ACI 347R (1994) Guide to Formwork for Concrete

## AMERICAN HARDBOARD ASSOCIATION (AHA)

AHA A135.4 (1995) Basic Hardboard

## U.S. DEPARTMENT OF COMMERCE (DOC)

PS1 (1996) Voluntary Product Standard -  
Construction and Industrial Plywood

## 1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

## SD-02 Shop Drawings

Formwork; G, AO.

Drawings showing details of formwork, including dimensions of fiber voids, joints, supports, studding and shoring, and sequence of form and shoring removal.

## SD-03 Product Data

Design; G, AO.

Design analysis and calculations for form design and methodology used in the design.

Form Materials; G, AO.

Manufacturer's data including literature describing form materials, accessories, and form releasing agents.

Form Releasing Agents; G, AO.

Manufacturer's recommendation on method and rate of application of form releasing agents.

### 1.3 DESIGN

Formwork shall be designed in accordance with methodology of ACI 347R for anticipated loads, lateral pressures, and stresses. Forms shall be capable of producing a surface which meets the requirements of the class of finish specified in Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE. Forms shall be capable of withstanding the pressures resulting from placement and vibration of concrete.

## PART 2 PRODUCTS

### 2.1 FORM MATERIALS

#### 2.1.1 Forms For Class A and Class B Finish

Forms for Class A and Class B finished surfaces shall be plywood panels conforming to PS1, Grade B-B concrete form panels, Class I or II. Other form materials or liners may be used provided the smoothness and appearance of concrete produced will be equivalent to that produced by the plywood concrete form panels. Forms for round columns shall be the prefabricated seamless type.

#### 2.1.2 Forms For Class C Finish

Forms for Class C finished surfaces shall be shiplap lumber; plywood conforming to PS1, Grade B-B concrete form panels, Class I or II; tempered concrete form hardboard conforming to AHA A135.4; other approved concrete form material; or steel, except that steel lining on wood sheathing shall not be used. Forms for round columns may have one vertical seam.

#### 2.1.3 Forms For Class D Finish

Forms for Class D finished surfaces, except where concrete is placed against earth, shall be wood or steel or other approved concrete form material.

#### 2.1.4 Form Ties

Form ties shall be factory-fabricated metal ties, shall be of the removable or internal disconnecting or snap-off type, and shall be of a design that will not permit form deflection and will not spall concrete upon removal. Solid backing shall be provided for each tie. Except where removable tie rods are used, ties shall not leave holes in the concrete surface less than 6 mm nor more than 25 mm deep and not more than 25 mm in diameter. Removable tie rods shall be not more than 38 mm in diameter.

#### 2.1.5 Form Releasing Agents

Form releasing agents shall be commercial formulations that will not bond with, stain or adversely affect concrete surfaces. Agents shall not impair subsequent treatment of concrete surfaces depending upon bond or adhesion nor impede the wetting of surfaces to be cured with water or curing compounds.

## PART 3 EXECUTION

### 3.1 INSTALLATION

#### 3.1.1 Formwork

Forms shall be mortar tight, properly aligned and adequately supported to produce concrete surfaces meeting the surface requirements specified in Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE and conforming to construction tolerance given in TABLE 1. At locations of visible, exposed concrete provide Class A finish to approximate the finish of similarly exposed existing concrete. Where concrete surfaces are to have a Class A or Class B finish, joints in form panels shall be arranged as approved. Where forms for continuous surfaces are placed in successive units, the forms shall fit over the completed surface to obtain accurate alignment of the surface and to prevent leakage of mortar. Forms shall not be reused if there is any evidence of surface wear and tear or defects which would impair the quality of the surface. Surfaces of forms to be reused shall be cleaned of mortar from previous concreting and of all other foreign material before reuse. Form ties that are to be completely withdrawn shall be coated with a nonstaining bond breaker.

#### 3.2 CHAMFERING

Except as otherwise shown, external corners that will be exposed shall be chamfered, beveled, or rounded by moldings placed in the forms.

#### 3.3 COATING

Forms for Class A and Class B finished surfaces shall be coated with a form releasing agent before the form or reinforcement is placed in final position. The coating shall be used as recommended in the manufacturer's printed or written instructions. Forms for Class C finished surfaces may be wet with water in lieu of coating immediately before placing concrete, except that in cold weather with probable freezing temperatures, coating shall be mandatory. Surplus coating on form surfaces and coating on reinforcing steel and construction joints shall be removed before placing concrete.

#### 3.4 REMOVAL OF FORMS

Forms shall be removed preventing injury to the concrete and ensuring the complete safety of the structure. Formwork for columns, walls, side of beams and other parts not supporting the weight of concrete may be removed when the concrete has attained sufficient strength to resist damage from the removal operation but not before at least 24 hours has elapsed since concrete placement. Supporting forms and shores shall not be removed from beams, floors and walls until the structural units are strong enough to carry their own weight and any other construction or natural loads. Supporting forms or shores shall not be removed before the concrete strength has reached 70 percent of design strength, as determined by field cured cylinders or other approved methods. This strength shall be demonstrated by job-cured test specimens, and by a structural analysis considering the proposed loads in relation to these test strengths and the strength of forming and shoring system. The job-cured test specimens for form removal purposes shall be provided in numbers as directed and shall be in addition to those required for concrete quality control. The specimens shall be removed from molds at the age of 24 hours and shall receive, insofar as possible, the same curing and protection as the structures they represent.

TABLE 1

TOLERANCES FOR FORMED SURFACES

1. Variations from the plumb:	In any 3 m of length ----- 6 mm
a. In the lines and surfaces of columns, piers, walls and in arises	Maximum for entire length -- 25 mm
b. For exposed corner columns, control-joint grooves, and other conspicuous lines	In any 6 m of length ----- 6 mm Maximum for entire length 13 mm
2. Variation from the level or from the grades indicated on the drawings:	In any 3 m of length ----- 6 mm In any bay or in any 6 m of length ----- 10 mm
a. In slab soffits, ceilings beam soffits, and in arises, measured before removal of supporting shores	Maximum for entire length - 20 mm
b. In exposed lintels, sills, parapets, horizontal grooves, and other conspicuous lines	In any bay or in any 6 m of length ----- 6 mm Maximum for entire length - 13 mm
3. Variation of the linear building lines from established position in plan	In any 6 m ----- 13 mm Maximum ----- 25 mm
4. Variation of distance between walls, columns, partitions	6 mm per 3 m of distance, but not more than 13 mm in any one bay, and not more than 25 mm total variation
5. Variation in the sizes and locations of sleeves, floor openings, and wall opening	Minus ----- 6 mm Plus ----- 13 mm
6. Variation in cross-sectional dimensions of columns and beams and in the thickness of slabs and walls	Minus ----- 6 mm Plus ----- 13 mm
7. Footings:	

TABLE 1

TOLERANCES FOR FORMED SURFACES

a.	Variation of dimensions in plan	Minus ----- 13 mm Plus ----- 50 mm when formed or plus 75 mm when placed against unformed excavation
b.	Misplacement of eccentricity	2 percent of the footing width in the direction of misplacement but not more than ----- 50 mm
c.	Reduction in thickness	Minus ----- 5 percent of specified thickness
8.	Variation in steps:	Riser ----- 3 mm
a.	In a flight of stairs	Tread ----- 6 mm
b.	In consecutive steps	Riser ----- 2 mm Tread ----- 3 mm
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## SECTION 03150

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05/98

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## SECTION 03150

EXPANSION JOINTS, CONTRACTION JOINTS, AND WATERSTOPS  
05/98

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS  
(AASHTO)

AASHTO T 111 (1983; R 1996)) Inorganic Matter or Ash in Bituminous Materials

## AMERICAN HARDBOARD ASSOCIATION (AHA)

AHA A135.4 (1995) Basic Hardboard

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 919 (1984; R 1998) Use of Sealants in Acoustical Applications

ASTM C 920 (1998) Elastomeric Joint Sealants

ASTM D 4 (1986; R 1998) Bitumen Content

ASTM D 6 (1995) Loss on Heating of Oil and Asphaltic Compounds

ASTM D 412 (1998a) Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers - Tension

ASTM D 471 (1998el) Rubber Property - Effect of Liquids

ASTM D 1190 (1997) Concrete Joint Sealer, Hot-Applied Elastic Type

ASTM D 1191 (1984; R 1994el) Concrete Joint Sealers

ASTM D 1751 (1999) Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)

ASTM D 1752 (1984; R 1996el) Preformed Sponge Rubber and Cork Expansion Joint Fillers for



## Concrete Paving and Structural Construction

ASTM D 1854	(1996) Jet-Fuel-Resistant Concrete Joint Sealer, Hot-Poured Elastic Type
ASTM D 2628	(1991; R 1998) Preformed Polychloroprene Elastomeric Joint Seals for Concrete Pavements
ASTM D 2835	(1989; R 1998) Lubricant for Installation of Preformed Compression Seals in Concrete Pavements
ASTM D 5249	(1995) Backer Material for Use With Cold and Hot-Applied Joint Sealants in Portland-Cement Concrete and Asphalt Joints
ASTM D 5329	(1996) Standard Test Method for Sealants and Fillers, Hot-Applied, for Joints and Cracks in Asphaltic and Portland Cement Concrete Pavements

## U.S. ARMY CORPS OF ENGINEERS (USACE)

COE CRD-C 513	(1974) Corps of Engineers Specifications for Rubber Waterstops
COE CRD-C 572	(1974) Corps of Engineers Specifications for Polyvinylchloride Waterstop

## 1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

## SD-02 Shop Drawings

Waterstops.

Shop drawings and fabrication drawings provided by the manufacturer or prepared by the Contractor.

## SD-03 Product Data

Preformed Expansion Joint Filler.  
Sealant.  
Waterstops.

Manufacturer's literature, including safety data sheets, for preformed fillers and the lubricants used in their installation; field-molded sealants and primers (when required by sealant manufacturer); preformed compression seals; and waterstops.

Manufacturer's recommended instructions for installing preformed fillers, field-molded sealants; preformed compression seals; and waterstops; and for splicing non-metallic waterstops.

## SD-04 Samples

Lubricant for Preformed Compression Seals.

Specimens identified to indicate the manufacturer, type of material, size and quantity of material, and shipment or lot represented. Each sample shall be a piece not less than 3 m of 25 mm nominal width or wider seal or a piece not less than 4 m of compression seal less than 25 mm nominal width. One L of lubricant shall be provided.

Field-Molded Type.

Four liters of field-molded sealant and one L of primer (when primer is recommended by the sealant manufacturer) identified to indicate manufacturer, type of material, quantity, and shipment or lot represented.

Non-metallic Materials.

Specimens identified to indicate manufacturer, type of material, size, quantity of material, and shipment or lot represented. Each sample shall be a piece not less than 300 mm long cut from each 61 m of finished waterstop furnished, but not less than a total of 1 m of each type, size, and lot furnished. One splice sample of each size and type for every 50 splices made in the factory and every 10 splices made at the job site. The splice samples shall be made using straight run pieces with the splice located at the mid-length of the sample and finished as required for the installed waterstop. The total length of each splice shall be not less than 300 mm long.

## SD-07 Certificates

Preformed Expansion Joint Filler.  
Sealant.  
Waterstops.

Certificates of compliance stating that the joint filler and sealant materials and waterstops conform to the requirements specified.

## 1.3 DELIVERY AND STORAGE

Material delivered and placed in storage shall be stored off the ground and protected from moisture, dirt, and other contaminants. Sealants shall be delivered in the manufacturer's original unopened containers. Sealants whose shelf life has expired shall be removed from the site.

## PART 2 PRODUCTS

## 2.1 CONTRACTION JOINT STRIPS

Contraction joint strips shall be 3 mm (1/8 inch) thick tempered hardboard conforming to AHA A135.4, Class 1. In lieu of hardboard strips, rigid polyvinylchloride (PVC) or high impact polystyrene (HIPS) insert strips specifically designed to induce controlled cracking in slabs on grade may be used. Such insert strips shall have removable top section.

## 2.2 PREFORMED EXPANSION JOINT FILLER

Expansion joint filler shall be preformed material conforming to ASTM D 1751 or ASTM D 1752. Unless otherwise indicated, filler material shall be 10 mm (3/8 inch) thick and of a width applicable for the joint formed. Backer material, when required, shall conform to ASTM D 5249.

## 2.3 SEALANT

Joint sealant shall conform to the following:

### 2.3.1 Preformed Polychloroprene Elastomeric Type

ASTM D 2628.

### 2.3.2 Lubricant for Preformed Compression Seals

ASTM D 2835.

### 2.3.3 Hot-Poured Type

ASTM D 1190 tested in accordance with ASTM D 1191.

### 2.3.4 Field-Molded Type

ASTM C 920, Type M for horizontal joints or Type NS for vertical joints, Class 25, and Use NT. Bond breaker material shall be polyethylene tape, coated paper, metal foil or similar type materials. The back-up material shall be compressible, non-shrink, nonreactive with sealant, and non-absorptive material type such as extruded butyl or polychloroprene rubber.

### 2.3.5 Hot-Applied Jet-Fuel Resistant Type

ASTM D 1854 tested in accordance with ASTM D 5329.

## 2.4 WATERSTOPS

Intersection and change of direction waterstops shall be shop fabricated.

### 2.4.1 Non-Metallic Materials`

Non-metallic waterstops shall be manufactured from a prime virgin resin; reclaimed material is not acceptable. The compound shall contain plasticizers, stabilizers, and other additives to meet specified requirements. Rubber waterstops shall conform to COE CRD-C 513. Polyvinylchloride waterstops shall conform to COE CRD-C 572. Thermoplastic elastomeric rubber waterstops shall conform to ASTM D 471.

### 2.4.2 Non-Metallic Hydrophilic

Swellable strip type compound of polymer modified chloroprene rubber that swells upon contact with water shall conform to ASTM D 412 as follows: Tensile strength 2.9 MPa minimum; ultimate elongation 600 percent minimum. Hardness shall be 50 minimum on the type A durometer and the volumetric expansion ratio in distilled water at 20 degrees C shall be 3 to 1 minimum.

### 2.4.3 Preformed Elastic Adhesive

Preformed plastic adhesive waterstops shall be produced from blends of refined hydrocarbon resins and plasticizing compounds reinforced with inert mineral filler, and shall contain no solvents, asbestos, irritating fumes or obnoxious odors. The compound shall not depend on oxidizing, evaporating, or chemical action for its adhesive or cohesive strength.

#### 2.4.3.1 Chemical Composition

The chemical composition of the sealing compound shall meet the requirements shown below:

PERCENT BY WEIGHT			
COMPONENT	MIN.	MAX.	TEST
Bitumen (Hydrocarbon plastic)	50	70	ASTM D 4
Inert Mineral Filler	30	50	AASHTO T 111
Volatile Matter		2	ASTM D 6

#### 2.4.3.2 Adhesion Under Hydrostatic Pressure

The sealing compound shall not leak at the joints for a period of 24 hours under a vertical 2 m head pressure. In a separate test, the sealing compound shall not leak under a horizontal pressure of 65 kPa which is reached by slowly applying increments of 13 kPa every minute.

#### 2.4.3.3 Sag of Flow Resistance

Sagging shall not be detected when tested as follows: Fill a wooden form 25 mm wide and 150 mm long flush with sealing compound and place in an oven at 58 degrees C in a vertical position for 5 days.

#### 2.4.3.4 Chemical Resistance

The sealing compound when immersed separately in a 5% solution of caustic potash, a 5% solution of hydrochloric acid, 5% solution of sulfuric acid and a saturated hydrogen sulfide solution for 30 days at ambient room temperature shall show no visible deterioration.

### PART 3 EXECUTION

#### 3.1 JOINTS

Joints shall be installed at locations indicated and as authorized.

##### 3.1.1 Contraction Joints

Contraction joints may be constructed by inserting tempered hardboard strips or rigid PVC or HIPS insert strips into the plastic concrete using a steel parting bar, when necessary, or by cutting the concrete with a saw after concrete has set. Joints shall be approximately 3 mm wide and shall extend into the slab one-fourth the slab thickness, minimum, but not less than 25 mm.

##### 3.1.1.1 Joint Strips

Strips shall be of the required dimensions and as long as practicable. After the first floating, the concrete shall be grooved with a tool at the

joint locations. The strips shall be inserted in the groove and depressed until the top edge of the vertical surface is flush with the surface of the slab. The slab shall be floated and finished as specified. Working of the concrete adjacent to the joint shall be the minimum necessary to fill voids and consolidate the concrete. Where indicated, the top portion of the strip shall be sawed out after the curing period to form a recess for sealer. The removable section of PVC or HIPS strips shall be discarded and the insert left in place. True alignment of the strips shall be maintained during insertion.

#### 3.1.1.2 Sawed Joints

Joint sawing shall be early enough to prevent uncontrolled cracking in the slab, but late enough that this can be accomplished without appreciable spalling. Concrete sawing machines shall be adequate in number and power, and with sufficient replacement blades to complete the sawing at the required rate. Joints shall be cut to true alignment and shall be cut in sequence of concrete placement. Sludge and cutting debris shall be removed.

#### 3.1.2 Expansion Joints

Preformed expansion joint filler shall be used in expansion and isolation joints in slabs around columns and between slabs on grade and vertical surfaces where indicated. The filler shall extend the full slab depth, unless otherwise indicated. The edges of the joint shall be neatly finished with an edging tool of 3 mm (1/8 inch) radius, except where a resilient floor surface will be applied. Where the joint is to receive a sealant, the filler strips shall be installed at the proper level below the finished floor with a slightly tapered, dressed and oiled wood strip temporarily secured to the top to form a recess to the size shown on the drawings. The wood strip shall be removed after the concrete has set. Contractor may opt to use a removable expansion filler cap designed and fabricated for this purpose in lieu of the wood strip. The groove shall be thoroughly cleaned of laitance, curing compound, foreign materials, protrusions of hardened concrete, and any dust which shall be blown out of the groove with oil-free compressed air.

#### 3.1.3 Joint Sealant

Sawed contraction joints and expansion joints in slabs shall be filled with joint sealant, unless otherwise shown. Joint surfaces shall be clean, dry, and free of oil or other foreign material which would adversely affect the bond between sealant and concrete. Joint sealant shall be applied as recommended by the manufacturer of the sealant.

##### 3.1.3.1 Joints With Preformed Compression Seals

Compression seals shall be installed with equipment capable of installing joint seals to the prescribed depth without cutting, nicking, twisting, or otherwise distorting or damaging the seal or concrete and with no more than 5 percent stretching of the seal. The sides of the joint and, if necessary, the sides of the compression seal shall be covered with a coating of lubricant. Butt joints shall be coated with liberal applications of lubricant.

##### 3.1.3.2 Joints With Field-Molded Sealant

Joints shall not be sealed when the sealant material, ambient air, or concrete temperature is less than 4 degrees C. When the sealants are meant

to reduce the sound transmission characteristics of interior walls, ceilings, and floors the guidance provided in ASTM C 919 shall be followed. Joints requiring a bond breaker shall be coated with curing compound or with bituminous paint. Bond breaker and back-up material shall be installed where required. Joints shall be primed and filled flush with joint sealant in accordance with the manufacturer's recommendations.

### 3.2 WATERSTOPS, INSTALLATION AND SPLICES

Waterstops shall be installed at the locations shown to form a continuous water-tight diaphragm. Adequate provision shall be made to support and completely protect the waterstops during the progress of the work. Any waterstop punctured or damaged shall be repaired or replaced. Exposed waterstops shall be protected during application of form release agents to avoid being coated. Suitable guards shall be provided to protect exposed projecting edges and ends of partially embedded waterstops from damage when concrete placement has been discontinued. Splices shall be made by certified trained personnel using approved equipment and procedures.

#### 3.2.1 Non-Metallic

Fittings shall be shop made using a machine specifically designed to mechanically weld the waterstop. A miter guide, proper fixturing (profile dependant), and portable power saw shall be used to miter cut the ends to be joined to ensure good alignment and contact between joined surfaces. The splicing of straight lengths shall be done by squaring the ends to be joined. Continuity of the characteristic features of the cross section of the waterstop (ribs, tabular center axis, protrusions, etc.) shall be maintained across the splice.

##### 3.2.1.1 Rubber Waterstop

Splices shall be vulcanized or shall be made using cold bond adhesive as recommended by the manufacturer. Splices for TPE-R shall be as specified for PVC.

##### 3.2.1.2 Polyvinyl Chloride Waterstop

Splices shall be made by heat sealing the adjacent waterstop edges together using a thermoplastic splicing iron utilizing a non-stick surface specifically designed for waterstop welding. The correct temperature shall be used to sufficiently melt without charring the plastic. The spliced area, when cooled, shall show no signs of separation, holes, or other imperfections when bent by hand in as sharp an angle as possible.

##### 3.2.1.3 Quality Assurance

Edge welding will not be permitted. Centerbulbs shall be compressed or closed when welding to non-centerbulb type. Waterstop splicing defects which are unacceptable include, but are not limited to the following: 1) Tensile strength less than 80 percent of parent section. 2) Free lap joints. 3) Misalignment of centerbulb, ribs, and end bulbs greater than 2 mm. 4) Misalignment which reduces waterstop cross section more than 15 percent. 5) Bond failure at joint deeper than 2 mm or 15 percent of material thickness. 6) Misalignment of waterstop splice resulting in misalignment of waterstop in excess of 13 mm in 3 m. 7) Visible porosity in the weld area, including pin holes. 8) Charred or burnt material. 9) Bubbles or inadequate bonding. 10) Visible signs of splice separation when cooled splice is bent by hand at a sharp angle.

### 3.2.2 Non-Metallic Hydrophilic Waterstop Installation

Ends to be joined shall be miter cut with sharp knife or shears. The ends shall be adhered with cyanacrylate (super glue) adhesive. When joining hydrophilic type waterstop to PVC waterstop, the hydrophilic waterstop shall be positioned as shown on the drawings. A liberal amount of a single component hydrophilic sealant shall be applied to the junction to complete the transition.

### 3.2.3 Preformed Plastic Adhesive Installation

The installation of preformed plastic adhesive waterstops shall be a prime, peel, place and pour procedure. Joint surfaces shall be clean and dry before priming and just prior to placing the sealing strips. The end of each strip shall be spliced to the next strip with a 25 mm overlap; the overlap shall be pressed firmly to release trapped air. During damp or cold conditions the joint surface shall be flashed with a safe, direct flame to warm and dry the surface adequately; the sealing strips shall be dipped in warm water to soften the material to achieve maximum bond to the concrete surface.

## 3.3 CONSTRUCTION JOINTS

Construction joints are specified in Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE except that construction joints coinciding with expansion and contraction joints shall be treated as expansion or contraction joints as applicable.

-- End of Section --

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SECTION 03200

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## SECTION 03200

CONCRETE REINFORCEMENT  
**09/97**

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 53	(1999) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 184/A 184M	(1996) Fabricated Deformed Steel Bar Mats for Concrete Reinforcement
ASTM A 185	(1997) Steel Welded Wire Fabric, Plain, for Concrete Reinforcement
ASTM A 497	(1997) Steel Welded Wire Fabric, Deformed, for Concrete Reinforcement
ASTM A 615/A 615M	(2000) Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM A 675/A 675M	(1990a; R 1995e1) Steel Bars, Carbon, Hot-Wrought, Special Quality, Mechanical Properties
ASTM A 706/A 706M	(1998) Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement
ASTM A 884/A 884M	(1996ae1) Epoxy-Coated Steel Wire and Welded Wire Fabric for Reinforcement

## AMERICAN WELDING SOCIETY (AWS)

AWS D1.4	(1998) Structural Welding Code - Reinforcing Steel
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## CONCRETE REINFORCING STEEL INSTITUTE (CRSI)

CRSI 1 MSP	(1996) Manual of Standard Practice
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## 1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be

submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Reinforcement; G, AE.

Detail drawings showing reinforcing steel placement, schedules, sizes, grades, and splicing and bending details. Drawings shall show support details including types, sizes and spacing.

SD-03 Product Data

Welding; G, AO.

A list of qualified welders names.

SD-07 Certificates

Reinforcing Steel; G, AO.

Certified copies of mill reports attesting that the reinforcing steel furnished contains no less than 25 percent recycled scrap steel and meets the requirements specified herein, prior to the installation of reinforcing steel.

1.3 WELDING

Welders shall be qualified in accordance with AWS D1.4. Qualification test shall be performed at the worksite and the Contractor shall notify the Contracting Officer 24 hours prior to conducting tests. Special welding procedures and welders qualified by others may be accepted as permitted by AWS D1.4.

1.4 DELIVERY AND STORAGE

Reinforcement and accessories shall be stored off the ground on platforms, skids, or other supports.

PART 2 PRODUCTS

2.1 DOWELS

Dowels shall conform to ASTM A 675/A 675M, Grade 80. Steel pipe conforming to ASTM A 53, Schedule 80, may be used as dowels provided the ends are closed with metal or plastic inserts or with mortar.

2.2 FABRICATED BAR MATS

Fabricated bar mats shall conform to ASTM A 184/A 184M.

2.3 REINFORCING STEEL

Reinforcing steel shall be deformed bars conforming to ASTM A 615/A 615M or ASTM A 706/A 706M, grades and sizes as indicated.

2.4 WELDED WIRE FABRIC

Welded wire fabric shall conform to ASTM A 185 ASTM A 497. When directed by the Contracting Officer for special applications, welded wire fabric

shall conform to ASTM A 884/A 884M.

## 2.5 WIRE TIES

Wire ties shall be 16 gauge or heavier black annealed steel wire.

## 2.6 SUPPORTS

Bar supports for formed surfaces shall be designed and fabricated in accordance with CRSI 1 MSP and shall be steel or precast concrete blocks. Precast concrete blocks shall have wire ties and shall be not less than 100 by 100 mm when supporting reinforcement on ground. Precast concrete block shall have compressive strength equal to that of the surrounding concrete. Where concrete formed surfaces will be exposed to weather or where surfaces are to be painted, steel supports within 13 mm of concrete surface shall be galvanized, plastic protected or of stainless steel. Concrete supports used in concrete exposed to view shall have the same color and texture as the finish surface. For slabs on grade, supports shall be precast concrete blocks, plastic coated steel fabricated with bearing plates, or specifically designed wire-fabric supports fabricated of plastic.

# PART 3 EXECUTION

## 3.1 REINFORCEMENT

Reinforcement shall be fabricated to shapes and dimensions shown and shall conform to the requirements of ACI 318M/318RM. Reinforcement shall be cold bent unless otherwise authorized. Bending may be accomplished in the field or at the mill. Bars shall not be bent after embedment in concrete. Safety caps shall be placed on all exposed ends of vertical concrete reinforcement bars that pose a danger to life safety. Wire tie ends shall face away from the forms.

### 3.1.1 Placement

Reinforcement shall be free from loose rust and scale, dirt, oil, or other deleterious coating that could reduce bond with the concrete. Reinforcement shall be placed in accordance with ACI 318M/318RM at locations shown plus or minus one bar diameter. Reinforcement shall not be continuous through expansion joints and shall be as indicated through construction or contraction joints. Concrete coverage shall be as indicated or as required by ACI 318M/318RM. If bars are moved more than one bar diameter to avoid interference with other reinforcement, conduits or embedded items, the resulting arrangement of bars, including additional bars required to meet structural requirements, shall be approved before concrete is placed.

### 3.1.2 Splicing

Splices of reinforcement shall conform to ACI 318M/318RM and shall be made only as required or indicated. Splicing shall be by lapping or by mechanical or welded butt connection; except that lap splices shall not be used for bars larger than No. 11 unless otherwise indicated. Welding shall conform to AWS D1.4. Welded butt splices shall be full penetration butt welds. Lapped bars shall be placed in contact and securely tied or spaced transversely apart to permit the embedment of the entire surface of each bar in concrete. Lapped bars shall not be spaced farther apart than one-fifth the required length of lap or 150 mm. Mechanical butt splices shall be in accordance with the recommendation of the manufacturer of the

mechanical splicing device. Butt splices shall develop 125 percent of the specified minimum yield tensile strength of the spliced bars or of the smaller bar in transition splices. Bars shall be flame dried before butt splicing. Adequate jigs and clamps or other devices shall be provided to support, align, and hold the longitudinal centerline of the bars to be butt spliced in a straight line.

### 3.2 WELDED-WIRE FABRIC PLACEMENT

Welded-wire fabric shall be placed in slabs as indicated. Fabric placed in slabs on grade shall be continuous between expansion, construction, and contraction joints. Fabric placement at joints shall be as indicated. Lap splices shall be made in such a way that the overlapped area equals the distance between the outermost crosswires plus 50 mm. Laps shall be staggered to avoid continuous laps in either direction. Fabric shall be wired or clipped together at laps at intervals not to exceed 1.2 m. Fabric shall be positioned by the use of supports.

### 3.3 DOWEL INSTALLATION

Dowels shall be installed in slabs on grade at locations indicated and at right angles to joint being doweled. Dowels shall be accurately positioned and aligned parallel to the finished concrete surface before concrete placement. Dowels shall be rigidly supported during concrete placement. One end of dowels shall be coated with a bond breaker.

-- End of Section --

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## SECTION 03300

CAST-IN-PLACE STRUCTURAL CONCRETE  
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## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## ACI INTERNATIONAL (ACI)

ACI 117/117R	(1990; Errata) Standard Tolerances for Concrete Construction and Materials
ACI 211.1	(1991) Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete
ACI 211.2	(1998) Standard Practice for Selecting Proportions for Structural Lightweight Concrete
ACI 213R	(1987) Guide for Structural Lightweight Aggregate Concrete
ACI 214.3R	(1988; R 1997) Simplified Version of the Recommended Practice for Evaluation of Strength Test Results of Concrete
ACI 305R	(1999) Hot Weather Concreting
ACI 318/318R	(1999) Building Code Requirements for Structural Concrete and Commentary

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS  
(AASHTO)

AASHTO M 182	(1991; R 1996) Burlap Cloth Made from Jute or Kenaf
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## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 1017/C 1017M	(1998) Chemical Admixtures for Use in Producing Flowing Concrete
ASTM C 1059	(1999) Latex Agents for Bonding Fresh to Hardened Concrete
ASTM C 1064/C 1064M	(1999) Temperature of Freshly Mixed Portland Cement Concrete
ASTM C 1077	(1998) Laboratories Testing Concrete and

	Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation
ASTM C 1107	(1999) Packaged Dry, Hydraulic-Cement Grout(Nonshrink)
ASTM C 136	(1996a) Sieve Analysis of Fine and Coarse Aggregates
ASTM C 143/C 143M	(2000) Slump of Hydraulic Cement Concrete
ASTM C 150	(1999a) Portland Cement
ASTM C 172	(1999) Sampling Freshly Mixed Concrete
ASTM C 173	(1996) Air Content of Freshly Mixed Concrete by the Volumetric Method
ASTM C 192/C 192M	(2000) Making and Curing Concrete Test Specimens in the Laboratory
ASTM C 231	(1997e1) Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C 260	(2000) Air-Entraining Admixtures for Concrete
ASTM C 31/C 31M	(2000e1) Making and Curing Concrete Test Specimens in the Field
ASTM C 33	(1999ae1) Concrete Aggregates
ASTM C 330	(2000) Lightweight Aggregates for Structural Concrete
ASTM C 39/C 39M	(2001) Compressive Strength of Cylindrical Concrete Specimens
ASTM C 42/C 42M	(1999) Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
ASTM C 494/C 494M	(1999ae1) Chemical Admixtures for Concrete
ASTM C 567	(2000) Unit Weight of Structural Lightweight Concrete
ASTM C 618	(2000) Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete
ASTM C 78	(1994) Flexural Strength of Concrete (Using Simple Beam With Third-Point Loading)
ASTM C 881	(1999) Epoxy-Resin-Base Bonding Systems for Concrete
ASTM C 937	(1997) Grout Fluidifier for

## Preplaced-Aggregate Concrete

ASTM C 94/C 94M	(2000e2) Ready-Mixed Concrete
ASTM C 940	(1998a) Expansion and Bleeding of Freshly Mixed Grouts for Preplaced-Aggregate Concrete in the Laboratory
ASTM D 1751	(1999) Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
ASTM D 75	(1987; R 1997) Sampling Aggregates

## NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NIST)

NIST HB 44	(1997) NIST Handbook 44: Specifications, Tolerances, and other Technical Requirements for Weighing and Measuring Devices
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## NATIONAL READY-MIXED CONCRETE ASSOCIATION (NRMCA)

NRMCA CPMB 100	(1996) Concrete Plant Standards \n/c\$\X
NRMCA QC 3	(1984) Quality Control Manual: Section 3, Plant Certifications Checklist: Certification of Ready Mixed Concrete Production Facilities
NRMCA TMMB 100	(1994) Truck Mixer Agitator and Front Discharge Concrete Carrier Standards

## U.S. ARMY CORPS OF ENGINEERS (USACE)

COE CRD-C 104	(1980) Method of Calculation of the Fineness Modulus of Aggregate
COE CRD-C 400	(1963) Requirements for Water for Use in Mixing or Curing Concrete
COE CRD-C 521	(1981) Standard Test Method for Frequency and Amplitude of Vibrators for Concrete
COE CRD-C 540	(1971; R 1981) Standard Specification for Nonbituminous Inserts for Contraction Joints in Portland Cement Concrete Airfield Pavements, Sawable Type
COE CRD-C 572	(1974) Corps of Engineers Specifications for Polyvinylchloride Waterstop
COE CRD-C 94	(1995) Surface Retarders

## 1.2 LUMP SUM CONTRACT

Under this type of contract concrete items will be paid for by lump sum and will not be measured. The work covered by these items consists of

furnishing all concrete materials, reinforcement, miscellaneous embedded materials, and equipment, and performing all labor for the forming, manufacture, transporting, placing, finishing, curing, and protection of concrete in these structures.

### 1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

#### SD-03 Product Data

Mixture Proportions; G, AE.

The results of trial mixture design studies along with a statement giving the maximum nominal coarse aggregate size and the proportions of ingredients that will be used in the manufacture of each strength or class of concrete, at least 14 days prior to commencing concrete placing operations. Aggregate weights shall be based on the saturated surface dry condition. The statement shall be accompanied by test results from an approved independent commercial testing laboratory, showing that mixture design studies have been made with materials proposed for the project and that the proportions selected will produce concrete of the qualities indicated. No substitutions shall be made in the materials used in the mixture design studies without additional tests to show that the quality of the concrete is satisfactory.

Lightweight Aggregate Concrete; G, AE.

Written recommendations from lightweight aggregate supplier on batching and mixing cycles.

#### SD-04 Samples

Surface Retarder; G, AO.

Sample of surface retarder material with manufacturer's instructions for application in conjunction with air-water cutting.

#### SD-06 Test Reports

Testing and Inspection for Contractor Quality Control; G, DO.

Certified copies of laboratory test reports, including mill tests and all other test data, for portland cement, blended cement, pozzolan, ground granulated blast furnace slag, silica fume, aggregate, admixtures, and curing compound proposed for use on this project.

#### SD-07 Certificates

Qualifications; G, AO.

Written documentation for Contractor Quality Control personnel.

#### 1.4 QUALIFICATIONS

Contractor Quality Control personnel assigned to concrete construction shall be American Concrete Institute (ACI) Certified Workmen in one of the following grades or shall have written evidence of having completed similar qualification programs:

Concrete Field Testing Technician, Grade I  
Concrete Laboratory Testing Technician, Grade I or II  
Concrete Construction Inspector, Level II

Concrete Transportation Construction Inspector or  
Reinforced Concrete Special Inspector, Jointly certified by American Concrete Institute (ACI), Building Official and Code Administrators International (BOCA), International Conference of Building Officials (ICBO), and Southern Building Code Congress International (SBCCI).

The foreman or lead journeyman of the flatwork finishing crew shall have similar qualification for ACI Concrete Flatwork Technician/Finisher or equal, with written documentation.

#### 1.5 FIELD TEST PANELS

Field test panels shall be constructed prior to beginning of work using the materials and procedures proposed for use on the job, to demonstrate the results to be attained. The quality and appearance of each panel shall be subject to the approval of the Contracting Officer, and, if not judged satisfactory, additional panels shall be constructed until approval is attained. Formed or finished surfaces in the completed structure shall match the quality and appearance of the approved field example.

#### 1.6 GENERAL REQUIREMENTS

##### 1.6.1 Tolerances

Except as otherwise specified herein, tolerances for concrete batching, mixture properties, and construction as well as definition of terms and application practices shall be in accordance with ACI 117/117R. Level and grade tolerance measurements of slabs shall be made as soon as possible after finishing; when forms or shoring are used, the measurements shall be made prior to removal.

##### 1.6.1.1 Floors

For the purpose of this Section the following terminology correlation between ACI 117/117R and this Section shall apply:

Floor Profile Quality Classification From ACI 117/117R	This Section
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Conventional Bullfloated	Same
Conventional Straightedged	Same
Flat	Float Finish or Trowel Finish

Levelness tolerance shall not apply where design requires floors to be sloped to drains or sloped for other reasons.

### 1.6.1.2 Floors by the Straightedge System

The flatness of the floors shall be carefully controlled and the tolerances shall be measured by the straightedge system as specified in paragraph 4.5.7 of ACI 117/117R, using a 3 m straightedge, within 72 hours after floor slab installation and before shores and/or forms are removed. The listed tolerances shall be met at any and every location at which the straightedge can be placed.

Bullfloated  
 Straightedged  
 Float Finish  
 Trowel Finish

### 1.6.2 Strength Requirements and w/c Ratio

#### 1.6.2.1 Strength Requirements

Specified compressive strength ( $f'_c$ ) shall be as follows:

COMPRESSIVE STRENGTH	STRUCTURE OR PORTION OF STRUCTURE
34.47 MPa at 28 days	Site Retaining Walls, C.O.C. Walls and Roof Slab
27.58 MPa at 28 days	Slabs
20.68 MPa at 28 days	Foundations

Concrete slabs on-grade shall have a 28-day flexural strength of 4.5 MPa. Concrete made with high-early strength cement shall have a 7-day strength equal to the specified 28-day strength for concrete made with Type I or II portland cement. Compressive strength shall be determined in accordance with ASTM C 39/C 39M. Flexural strength shall be determined in accordance with ASTM C 78.

- a. Evaluation of Concrete Compressive Strength. Compressive strength specimens (152 by 305 mm cylinders) shall be fabricated by the Contractor and laboratory cured in accordance with ASTM C 31/C 31M and tested in accordance with ASTM C 39/C 39M. The strength of the concrete will be considered satisfactory so long as the average of all sets of three consecutive test results equals or exceeds the specified compressive strength  $f'_c$  and no individual test result falls below the specified strength  $f'_c$  by more than 3.5 MPa. A "test" is defined as the average of two companion cylinders, or if only one cylinder is tested, the results of the single cylinder test. Additional analysis or testing, including taking cores and/or load tests may be required at the Contractor's expense when the strength of the concrete in the structure is considered potentially deficient.
- b. Investigation of Low-Strength Compressive Test Results. When any strength test of standard-cured test cylinders falls below the specified strength requirement by more than 3.5 MPa or if tests of field-cured cylinders indicate deficiencies in protection and curing, steps shall be taken to assure that the load-carrying capacity of the structure is not jeopardized. When the strength of concrete in place is considered potentially deficient, cores shall be obtained and tested in accordance with ASTM C 42/C 42M.

At least three representative cores shall be taken from each member or area of concrete in place that is considered potentially deficient. The location of cores will be determined by the Contracting Officer to least impair the strength of the structure.

Concrete in the area represented by the core testing will be considered adequate if the average strength of the cores is equal to at least 85 percent of the specified strength requirement and if no single core is less than 75 percent of the specified strength requirement. Non-destructive tests (tests other than test cylinders or cores) shall not be used as a basis for acceptance or rejection. The Contractor shall perform the coring and repair the holes. Cores will be tested by the Government.

- c. Load Tests. If the core tests are inconclusive or impractical to obtain or if structural analysis does not confirm the safety of the structure, load tests may be directed by the Contracting Officer in accordance with the requirements of ACI 318/318R. Concrete work evaluated by structural analysis or by results of a load test as being understrength shall be corrected in a manner satisfactory to the Contracting Officer. All investigations, testing, load tests, and correction of deficiencies shall be performed by and at the expense of the Contractor and must be approved by the Contracting Officer, except that if all concrete is found to be in compliance with the drawings and specifications, the cost of investigations, testing, and load tests will be at the expense of the Government.
- d. Evaluation of Concrete Flexural Strength. Flexural strength specimens (beams) shall be fabricated by the Contractor and laboratory cured in accordance with ASTM C 31/C 31M and tested in accordance with ASTM C 78. The strength of the concrete will be considered satisfactory so long as the average of all sets of three consecutive test results equals or exceeds the specified flexural strength and no individual test result falls below the specified flexural strength by more than 350 kPa. A "test" is defined as the average of two companion beams. Additional analysis or testing, including taking cores and/or load tests may be required at the Contractor's expense when the strength of the concrete in the slab is considered potentially deficient.

#### 1.6.2.2 Water-Cement Ratio

Maximum water-cement ratio (w/c) for normal weight concrete shall be as follows:

WATER-CEMENT RATIO, BY WEIGHT	STRUCTURE OR PORTION OF STRUCTURE
0.45	Concrete Exposed to Freezing and Thawing

These w/c's may cause higher strengths than that required above for compressive or flexural strength. The maximum w/c required will be the equivalent w/c as determined by conversion from the weight ratio of water to cement plus pozzolan, silica fume, and ground granulated blast furnace slag (GGBF slag) by the weight equivalency method as described in ACI 211.1.

In the case where silica fume or GGBF slag is used, the weight of the silica fume and GGBF slag shall be included in the equations of ACI 211.1 for the term P which is used to denote the weight of pozzolan.

#### 1.6.3 Air Entrainment



Light weight concrete shall not be air entrained.

#### 1.6.4 Slump

Slump of the concrete, as delivered to the point of placement into the forms, shall be within the following limits. Slump shall be determined in accordance with ASTM C 143/C 143M.

Structural Element	Slump	
	Minimum	Maximum
Walls, columns and beams	25 mm	100 mm
Foundation walls, substructure walls, footings, slabs	25 mm	75 mm
Any structural concrete approved for placement by pumping:		
At pump	50 mm	150 mm
At discharge of line	25 mm	100 mm

When use of a plasticizing admixture conforming to ASTM C 1017/C 1017M or when a Type F or G high range water reducing admixture conforming to ASTM C 494/C 494M is permitted to increase the slump of concrete, concrete shall have a slump of 50 to 100 mm before the admixture is added and a maximum slump of 200 mm at the point of delivery after the admixture is added. For troweled floors, slump of structural lightweight concrete with normal weight sand placed by pump shall not exceed 125 mm at the point of placement. For other slabs, slump of lightweight concrete shall not exceed 100 mm at point of placement.

#### 1.6.5 Concrete Temperature

The temperature of the concrete as delivered shall not exceed 32 degrees C. When the ambient temperature during placing is 5 degrees C or less, or is expected to be at any time within 6 hours after placing, the temperature of the concrete as delivered shall be between 12 and 25 degrees C.

#### 1.6.6 Size of Coarse Aggregate

The largest feasible nominal maximum size aggregate (NMSA) specified in paragraph AGGREGATES shall be used in each placement. However, nominal maximum size of aggregate shall not exceed any of the following: three-fourths of the minimum cover for reinforcing bars, three-fourths of the minimum clear spacing between reinforcing bars, one-fifth of the narrowest dimension between sides of forms, or one-third of the thickness of slabs or toppings.

#### 1.6.7 Special Properties and Products

Concrete may contain admixtures other than air entraining agents, such as water reducers, superplasticizers, or set retarding agents to provide special properties to the concrete, if specified or approved. Any of these materials to be used on the project shall be used in the mix design studies.

#### 1.6.8 Lightweight Aggregate Structural Concrete

Lightweight aggregate structural concrete shall conform to the requirements specified for normal weight concrete except as specified herein. 28 days compressive strength shall be determined by test specimens that have been air dried at 50 percent relative humidity for the last 21 days. Air-dry unit weight shall be not over  $1450 \text{ kg/m}^3$  at 28 days as determined by ASTM C 567. However, fresh unit weight shall be used for acceptance during concreting, using a correlation factor between the two types of unit weight as determined during mixture design studies. Lightweight aggregate structural concrete floor fill shall have a 28-day compressive strength of at least 17.3 MPa and an air-dry unit weight not exceeding 1850 kg/cubic meter.

#### 1.7 MIXTURE PROPORTIONS

Concrete shall be composed of portland cement, other cementitious and pozzolanic materials as specified, aggregates, water and admixtures as specified.

##### 1.7.1 Proportioning Studies for Normal Weight Concrete

Trial design batches, mixture proportioning studies, and testing requirements for various classes and types of concrete specified shall be the responsibility of the Contractor. Except as specified for flexural strength concrete, mixture proportions shall be based on compressive strength as determined by test specimens fabricated in accordance with ASTM C 192/C 192M and tested in accordance with ASTM C 39/C 39M. Samples of all materials used in mixture proportioning studies shall be representative of those proposed for use in the project and shall be accompanied by the manufacturer's or producer's test reports indicating compliance with these specifications. Trial mixtures having proportions, consistencies, and air content suitable for the work shall be made based on methodology described in ACI 211.1, using at least three different water-cement ratios for each type of mixture, which will produce a range of strength encompassing those required for each class and type of concrete required on the project. The maximum water-cement ratios required in subparagraph Water-Cement Ratio will be the equivalent water-cement ratio as determined by conversion from the weight ratio of water to cement plus pozzolan, silica fume, and ground granulated blast furnace slag (GGBF slag) by the weight equivalency method as described in ACI 211.1. In the case where silica fume or GGBF slag is used, the weight of the silica fume and GGBF slag shall be included in the equations in ACI 211.1 for the term P, which is used to denote the weight of pozzolan. If pozzolan is used in the concrete mixture, the minimum pozzolan content shall be 15 percent by weight of the total cementitious material, and the maximum shall be 35 percent. Laboratory trial mixtures shall be designed for maximum permitted slump and air content. Separate sets of trial mixture studies shall be made for each combination of cementitious materials and each combination of admixtures proposed for use.

No combination of either shall be used until proven by such studies, except that, if approved in writing and otherwise permitted by these specifications, an accelerator or a retarder may be used without separate trial mixture study. Separate trial mixture studies shall also be made for concrete for any conveying or placing method proposed which requires special properties and for concrete to be placed in unusually difficult placing locations. The temperature of concrete in each trial batch shall be reported. For each water-cement ratio, at least three test cylinders or beams for each test age shall be made and cured in accordance with ASTM C 192/C 192M. They shall be tested at 7 and 28 days in accordance with ASTM C 39/C 39M. From these test results, a curve shall be plotted showing the

relationship between water-cement ratio and strength for each set of trial mix studies. In addition, a curve shall be plotted showing the relationship between 7 day and 28 day strengths. Each mixture shall be designed to promote easy and suitable concrete placement, consolidation and finishing, and to prevent segregation and excessive bleeding.

#### 1.7.2 Proportioning Studies for Flexural Strength Concrete

Trial design batches, mixture proportioning studies, and testing requirements shall conform to the requirements specified in paragraph Proportioning Studies for Normal Weight Concrete, except that proportions shall be based on flexural strength as determined by test specimens (beams) fabricated in accordance with ASTM C 192/C 192M and tested in accordance with ASTM C 78. Procedures given in ACI 211.1 shall be modified as necessary to accommodate flexural strength.

#### 1.7.3 Proportioning Studies for Lightweight Aggregate Structural Concrete

Trial design batches, mixture proportioning studies, and testing requirements shall conform to the requirements specified in paragraph Proportioning Studies for Normal Weight Concrete, except as follows. Trial mixtures having proportions, consistencies and air content suitable for the work shall be made based on methodology described in ACI 211.2, using at least three different cement contents. Trial mixes shall be proportioned to produce air dry unit weight and concrete strengths specified in paragraph GENERAL REQUIREMENTS. Trial mixtures shall be proportioned for maximum permitted slump and air content. Test specimens and testing shall be as specified for normal weight concrete except that 28-day compressive strength shall be determined from test cylinders that have been air dried at 50 percent relative humidity for the last 21 days. Air dry unit weight shall be determined in accordance with ASTM C 567 and shall be designed to be at least 32 kg per cubic meter less than the maximum specified air dry unit weight in paragraph GENERAL REQUIREMENTS. Curves shall be plotted using these results showing the relationship between cement factor and strength and air dry unit weight. Normal weight fine aggregate may be substituted for part or all of the lightweight fine aggregate, provided the concrete meets the strength and unit weight. A correlation shall also be developed showing the ratio between air dry unit weight and fresh concrete unit weight for each mix.

#### 1.7.4 Average Compressive Strength Required for Mixtures

The mixture proportions selected during mixture design studies shall produce a required average compressive strength ( $f'_{cr}$ ) exceeding the specified compressive strength ( $f'_c$ ) by the amount indicated below. This required average compressive strength,  $f'_{cr}$ , will not be a required acceptance criteria during concrete production. However, whenever the daily average compressive strength at 28 days drops below  $f'_{cr}$  during concrete production, or daily average 7-day strength drops below a strength correlated with the 28-day  $f'_{cr}$ , the mixture shall be adjusted, as approved, to bring the daily average back up to  $f'_{cr}$ . During production, the required  $f'_{cr}$  shall be adjusted, as appropriate, based on the standard deviation being attained on the job.

##### 1.7.4.1 Computations from Test Records

Where a concrete production facility has test records, a standard deviation shall be established in accordance with the applicable provisions of ACI 214.3R. Test records from which a standard deviation is calculated shall

represent materials, quality control procedures, and conditions similar to those expected; shall represent concrete produced to meet a specified strength or strengths ( $f'c$ ) within 7 MPa of that specified for proposed work; and shall consist of at least 30 consecutive tests. A strength test shall be the average of the strengths of two cylinders made from the same sample of concrete and tested at 28 days. Required average compressive strength  $f'cr$  used as the basis for selection of concrete proportions shall be the larger of the equations that follow using the standard deviation as determined above:

$$f'cr = f'c + 1.34S \text{ where units are in MPa}$$

$$f'cr = f'c + 2.33S - 3.45 \text{ where units are in MPa}$$

Where  $S$  = standard deviation

Where a concrete production facility does not have test records meeting the requirements above but does have a record based on 15 to 29 consecutive tests, a standard deviation shall be established as the product of the calculated standard deviation and a modification factor from the following table:

NUMBER OF TESTS	MODIFICATION FACTOR FOR STANDARD DEVIATION
15	1.16
20	1.08
25	1.03
30 or more	1.00

#### 1.7.4.2 Computations without Previous Test Records

When a concrete production facility does not have sufficient field strength test records for calculation of the standard deviation, the required average strength  $f'cr$  shall be determined as follows:

- a. If the specified compressive strength  $f'c$  is less than 20 MPa,

$$f'cr = f'c + 6.9 \text{ MPa}$$

- b. If the specified compressive strength  $f'c$  is 20 to 35 MPa,

$$f'cr = f'c + 8.3 \text{ MPa}$$

- c. If the specified compressive strength  $f'c$  is over 35 MPa,

$$f'cr = f'c + 9.7 \text{ MPa}$$

#### 1.7.5 Average Flexural Strength Required for Mixtures

The mixture proportions selected during mixture design studies for flexural strength mixtures and the mixture used during concrete production shall be designed and adjusted during concrete production as approved, except that the overdesign for average flexural strength shall simply be 15 percent greater than the specified flexural strength at all times.

#### 1.8 STORAGE OF MATERIALS

Cement and other cementitious materials shall be stored in weathertight

buildings, bins, or silos which will exclude moisture and contaminants and keep each material completely separated. Aggregate stockpiles shall be arranged and used in a manner to avoid excessive segregation and to prevent contamination with other materials or with other sizes of aggregates. Aggregate shall not be stored directly on ground unless a sacrificial layer is left undisturbed. Reinforcing bars and accessories shall be stored above the ground on platforms, skids or other supports. Other materials shall be stored in such a manner as to avoid contamination and deterioration. Admixtures which have been in storage at the project site for longer than 6 months or which have been subjected to freezing shall not be used unless retested and proven to meet the specified requirements. Materials shall be capable of being accurately identified after bundles or containers are opened.

#### 1.9 GOVERNMENT ASSURANCE INSPECTION AND TESTING

Day-to day inspection and testing shall be the responsibility of the Contractor Quality Control (CQC) staff. However, representatives of the Contracting Officer can and will inspect construction as considered appropriate and will monitor operations of the Contractor's CQC staff. Government inspection or testing will not relieve the Contractor of any of his CQC responsibilities.

##### 1.9.1 Materials

The Government will sample and test aggregates, cementitious materials, other materials, and concrete to determine compliance with the specifications as considered appropriate. The Contractor shall provide facilities and labor as may be necessary for procurement of representative test samples. Samples of aggregates will be obtained at the point of batching in accordance with ASTM D 75. Other materials will be sampled from storage at the jobsite or from other locations as considered appropriate. Samples may be placed in storage for later testing when appropriate.

##### 1.9.2 Fresh Concrete

Fresh concrete will be sampled as delivered in accordance with ASTM C 172 and tested in accordance with these specifications, as considered necessary.

##### 1.9.3 Hardened Concrete

Tests on hardened concrete will be performed by the Government when such tests are considered necessary.

##### 1.9.4 Inspection

Concrete operations may be tested and inspected by the Government as the project progresses. Failure to detect defective work or material will not prevent rejection later when a defect is discovered nor will it obligate the Government for final acceptance.

## PART 2 PRODUCTS

### 2.1 CEMENTITIOUS MATERIALS

Cementitious Materials shall be portland cement, portland-pozzolan cement, or portland cement in combination with pozzolan and shall conform to appropriate specifications listed below. Use of cementitious materials in

concrete which will have surfaces exposed in the completed structure shall be restricted so there is no change in color, source, or type of cementitious material.

#### 2.1.1 Portland Cement

ASTM C 150, Type I low alkali with a maximum 15 percent amount of tricalcium aluminate, or Type II low alkali. White portland cement shall meet the above requirements except that it may be Type I, Type II or Type III low alkali. White Type III shall be used only in specific areas of the structure, when approved in writing. The alkali content shall not exceed 0.6 percent. Sulfate-resistant cement is not required. Pozzolan may be used as a partial replacement for Portland Cement.

#### 2.1.2 High-Early-Strength Portland Cement

ASTM C 150, Type III with tricalcium aluminate limited to 5 percent. Type III cement shall be used only in isolated instances and only when approved in writing.

#### 2.1.3 Blended Cements

ASTM C 595M, Type IP.

#### 2.1.4 Pozzolan (Fly Ash)

ASTM C 618, Class F with the optional requirements for multiple factor, drying shrinkage, and uniformity from Table 2A of ASTM C 618. Requirement for maximum alkalis from Table 1A of ASTM C 618 shall apply. If pozzolan is used, it shall never be less than 15 percent nor more than 35 percent by weight of the total cementitious material. The Contractor shall comply with EPA requirements in accordance with Section 01670 RECYCLED / RECOVERED MATERIALS.

### 2.2 AGGREGATES

Aggregates shall conform to the following.

#### 2.2.1 Fine Aggregate

Fine aggregate shall conform to the quality and gradation requirements of ASTM C 33.

#### 2.2.2 Coarse Aggregate

Coarse aggregate shall conform to the lesser of ASTM C 33, Class 5S, size designation 4, V5 the narrowest dimension between sides of forms, 1/3 the depth of slabs, or 3/4 the minimum clear spacing between individual reinforcing bars, wires, or bundles of bars.

#### 2.2.3 Lightweight Aggregate

Lightweight fine and coarse aggregate shall conform to the quality and gradation requirements of ASTM C 330, size 19 mm to 5 mm for coarse aggregate. Lightweight aggregate shall be prewetted in accordance with the Manufacturer's instructions unless otherwise specified. For pumped concrete, prewetting shall be sufficient to ensure that slump loss through the pump line does not exceed 100 mm.

## 2.3 CHEMICAL ADMIXTURES

Chemical admixtures, when required or permitted, shall conform to the appropriate specification listed. Admixtures shall be furnished in liquid form and of suitable concentration for easy, accurate control of dispensing.

### 2.3.1 Air-Entraining Admixture

ASTM C 260 and shall consistently entrain the air content in the specified ranges under field conditions.

### 2.3.2 Accelerating Admixture

ASTM C 494/C 494M, Type C or E, except that calcium chloride or admixtures containing calcium chloride shall not be used.

### 2.3.3 Water-Reducing or Retarding Admixture

ASTM C 494/C 494M, Type A, B, or D, except that the 6-month and 1-year compressive and flexural strength tests are waived.

### 2.3.4 High-Range Water Reducer

ASTM C 494/C 494M, Type F or G, except that the 6-month and 1-year strength requirements are waived. The admixture shall be used only when approved in writing, such approval being contingent upon particular mixture control as described in the Contractor's Quality Control Plan and upon performance of separate mixture design studies.

### 2.3.5 Surface Retarder

COE CRD-C 94.

### 2.3.6 Expanding Admixture

Aluminum powder type expanding admixture conforming to ASTM C 937.

### 2.3.7 Other Chemical Admixtures

Chemical admixtures for use in producing flowing concrete shall comply with ASTM C 1017/C 1017M, Type I or II. These admixtures shall be used only when approved in writing, such approval being contingent upon particular mixture control as described in the Contractor's Quality Control Plan and upon performance of separate mixture design studies.

## 2.4 CURING MATERIALS

### 2.4.1 Burlap and Cotton Mat

Burlap and cotton mat used for curing shall conform to AASHTO M 182.

## 2.5 WATER

Water for mixing and curing shall be fresh, clean, potable, and free of injurious amounts of oil, acid, salt, or alkali, except that non-potable water may be used if it meets the requirements of COE CRD-C 400.

## 2.6 NONSHRINK GROUT

Nonshrink grout shall conform to ASTM C 1107, Grade B or C, and shall be a commercial formulation suitable for the proposed application.

## 2.7 LATEX BONDING AGENT

Latex agents for bonding fresh to hardened concrete shall conform to ASTM C 1059.

## 2.8 EPOXY RESIN

Epoxy resins for use in repairs shall conform to ASTM C 881, Type V, Grade 2. Class as appropriate to the existing ambient and surface temperatures.

## 2.9 EMBEDDED ITEMS

Embedded items shall be of the size and type indicated or as needed for the application. Dovetail slots shall be galvanized steel. Hangers for suspended ceilings shall be as specified in Section 09510 ACOUSTICAL CEILINGS. Inserts for shelf angles and bolt hangers shall be of malleable iron or cast or wrought steel.

## 2.10 PERIMETER INSULATION

Perimeter insulation shall be polystyrene conforming to ASTM C 578, Type II; polyurethane conforming to ASTM C 591, Type II; or cellular glass conforming to ASTM C 552, Type I or IV. The Contractor shall comply with EPA requirements in accordance with Section 01670 RECYCLED / RECOVERED MATERIALS.

## 2.11 VAPOR BARRIER

Vapor barrier shall be micoporated with product specified in Section 07170 BENTONITE GEOTEXTILE WATERPROOFING.

## 2.12 JOINT MATERIALS

### 2.12.1 Joint Fillers, Sealers, and Waterstops

Expansion joint fillers shall be preformed materials conforming to ASTM D 1751. Materials for waterstops shall be in accordance with Section 03150 EXPANSION JOINTS, CONTRACTION JOINTS, AND WATERSTOPS. Materials for and sealing of joints shall conform to the requirements of Section 07900 JOINT SEALING.

### 2.12.2 Contraction Joints in Slabs

Sawable type contraction joint inserts shall conform to COE CRD-C 540. Nonsawable joint inserts shall have sufficient stiffness to permit placement in plastic concrete without undue deviation from a straight line and shall conform to the physical requirements of COE CRD-C 540, with the exception of Section 3.4 "Resistance to Sawing". Plastic inserts shall be polyvinyl chloride conforming to the materials requirements of COE CRD-C 572.

## PART 3 EXECUTION

### 3.1 PREPARATION FOR PLACING

Before commencing concrete placement, the following shall be performed. Surfaces to receive concrete shall be clean and free from frost, ice, mud,



and water. Forms shall be in place, cleaned, coated, and adequately supported, in accordance with Section 03100 STRUCTURAL CONCRETE FORMWORK. Reinforcing steel shall be in place, cleaned, tied, and adequately supported, in accordance with Section 03200 CONCRETE REINFORCEMENT. Transporting and conveying equipment shall be in-place, ready for use, clean, and free of hardened concrete and foreign material. Equipment for consolidating concrete shall be at the placing site and in proper working order. Equipment and material for curing and for protecting concrete from weather or mechanical damage shall be at the placing site, in proper working condition and in sufficient amount for the entire placement. When hot, windy conditions during concreting appear probable, equipment and material shall be at the placing site to provide windbreaks, shading, fogging, or other action to prevent plastic shrinkage cracking or other damaging drying of the concrete.

### 3.1.1 Foundations

#### 3.1.1.1 Concrete on Earth Foundations

Earth (subgrade, base, or subbase courses) surfaces upon which concrete is to be placed shall be clean, damp, and free from debris, frost, ice, and standing or running water. Prior to placement of concrete, the foundation shall be well drained and shall be satisfactorily graded and uniformly compacted.

#### 3.1.1.2 Preparation of Rock

Rock surfaces upon which concrete is to be placed shall be free from oil, standing or running water, ice, mud, drummy rock, coating, debris, and loose, semidetached or unsound fragments. Joints in rock shall be cleaned to a satisfactory depth, as determined by the Contracting Officer, and to firm rock on the sides. Immediately before the concrete is placed, rock surfaces shall be cleaned thoroughly by the use of air-water jets or sandblasting as specified below for Previously Placed Concrete. Rock surfaces shall be kept continuously moist for at least 24 hours immediately prior to placing concrete thereon. All horizontal and approximately horizontal surfaces shall be covered, immediately before the concrete is placed, with a layer of mortar proportioned similar to that in the concrete mixture. Concrete shall be placed before the mortar stiffens.

#### 3.1.2 Previously Placed Concrete

Concrete surfaces to which additional concrete is to be bonded shall be prepared for receiving the next horizontal lift by cleaning the construction joint surface with either air-water cutting, sandblasting, high-pressure water jet, or other approved method. Concrete at the side of vertical construction joints shall be prepared as approved by the Contracting Officer. Air-water cutting shall not be used on formed surfaces or surfaces congested with reinforcing steel. Regardless of the method used, the resulting surfaces shall be free from all laitance and inferior concrete so that clean surfaces of well bonded coarse aggregate are exposed and make up at least 10-percent of the surface area, distributed uniformly throughout the surface. The edges of the coarse aggregate shall not be undercut. The surface of horizontal construction joints shall be kept continuously wet for the first 12 hours during the 24-hour period prior to placing fresh concrete. The surface shall be washed completely clean as the last operation prior to placing the next lift. For heavy duty floors and two-course floors a thin coat of neat cement grout of about the consistency of thick cream shall be thoroughly

scrubbed into the existing surface immediately ahead of the topping placing. The grout shall be a 1:1 mixture of portland cement and sand passing the 2.36 mm sieve. The topping concrete shall be deposited before the grout coat has had time to stiffen.

#### 3.1.2.1 Air-Water Cutting

Air-water cutting of a fresh concrete surface shall be performed at the proper time and only on horizontal construction joints. The air pressure used in the jet shall be 700 kPa plus or minus, 70 kPa, and the water pressure shall be just sufficient to bring the water into effective influence of the air pressure. When approved by the Contracting Officer, a surface retarder complying with the requirements of COE CRD-C 94 may be applied to the surface of the lift in order to prolong the period of time during which air-water cutting is effective. After cutting, the surface shall be washed and rinsed as long as there is any trace of cloudiness of the wash water. Where necessary to remove accumulated laitance, coatings, stains, debris, and other foreign material, high-pressure waterjet or sandblasting shall be used as the last operation before placing the next lift.

#### 3.1.2.2 High-Pressure Water Jet

A stream of water under a pressure of not less than 20 MPa shall be used for cutting and cleaning. Its use shall be delayed until the concrete is sufficiently hard so that only the surface skin or mortar is removed and there is no undercutting of coarse-aggregate particles. If the waterjet is incapable of a satisfactory cleaning, the surface shall be cleaned by sandblasting.

#### 3.1.2.3 Wet Sandblasting

Wet sandblasting shall be used after the concrete has reached sufficient strength to prevent undercutting of the coarse aggregate particles. After wet sandblasting, the surface of the concrete shall then be washed thoroughly to remove all loose materials.

#### 3.1.2.4 Waste Disposal

The method used in disposing of waste water employed in cutting, washing, and rinsing of concrete surfaces shall be such that the waste water does not stain, discolor, or affect exposed surfaces of the structures, or damage the environment of the project area. The method of disposal shall be subject to approval.

#### 3.1.2.5 Preparation of Previously Placed Concrete

Concrete surfaces to which other concrete is to be bonded shall be abraded in an approved manner that will expose sound aggregate uniformly without damaging the concrete. Laitance and loose particles shall be removed. Surfaces shall be thoroughly washed and shall be moist but without free water when concrete is placed.

#### 3.1.3 Vapor Barrier

Provide waterproofing beneath interior on-grade concrete floor slabs in accordance with Section 07170 BENTONITE GEOTEXTILE WATERPROOFING.

#### 3.1.4 Perimeter Insulation

Perimeter insulation shall be installed at locations indicated. Adhesive shall be used where insulation is applied to the interior surface of foundation walls and may be used for exterior application.

### 3.1.5 Embedded Items

Before placement of concrete, care shall be taken to determine that all embedded items are firmly and securely fastened in place as indicated on the drawings, or required. Conduit and other embedded items shall be clean and free of oil and other foreign matter such as loose coatings or rust, paint, and scale. The embedding of wood in concrete will be permitted only when specifically authorized or directed. Voids in sleeves, inserts, and anchor slots shall be filled temporarily with readily removable materials to prevent the entry of concrete into voids. Welding shall not be performed on embedded metals within 300 mm of the surface of the concrete. Tack welding shall not be performed on or to embedded items.

## 3.2 CONCRETE PRODUCTION

### 3.2.1 Batching, Mixing, and Transporting Concrete

Ready-mixed concrete shall be batched, mixed, and transported in accordance with ASTM C 94/C 94M, except as otherwise specified. Truck mixers, agitators, and nonagitating transporting units shall comply with NRMCA TMMB 100. Ready-mix plant equipment and facilities shall be certified in accordance with NRMCA QC 3. Approved batch tickets shall be furnished for each load of ready-mixed concrete.

#### 3.2.1.1 General

The batching plant shall be located off site close to the project. The batching, mixing and placing system shall have a capacity of at least 8 cubic meters per hour. The batching plant shall conform to the requirements of NRMCA CPMB 100 and as specified; however, rating plates attached to batch plant equipment are not required.

#### 3.2.1.2 Batching Equipment

The batching controls shall be semiautomatic or automatic, as defined in NRMCA CPMB 100. A semiautomatic batching system shall be provided with interlocks such that the discharge device cannot be actuated until the indicated material is within the applicable tolerance. The batching system shall be equipped with accurate recorder or recorders that meet the requirements of NRMCA CPMB 100. The weight of water and admixtures shall be recorded if batched by weight. Separate bins or compartments shall be provided for each size group of aggregate and type of cementitious material, to prevent intermingling at any time. Aggregates shall be weighed either in separate weigh batchers with individual scales or, provided the smallest size is batched first, cumulatively in one weigh batcher on one scale. Aggregate shall not be weighed in the same batcher with cementitious material. If both portland cement and other cementitious material are used, they may be batched cumulatively, provided that the portland cement is batched first. Water may be measured by weight or volume. Water shall not be weighed or measured cumulatively with another ingredient. Filling and discharging valves for the water metering or batching system shall be so interlocked that the discharge valve cannot be opened before the filling valve is fully closed. Piping for water and for admixtures shall be free from leaks and shall be properly valved to prevent

backflow or siphoning. Admixtures shall be furnished as a liquid of suitable concentration for easy control of dispensing. An adjustable, accurate, mechanical device for measuring and dispensing each admixture shall be provided. Each admixture dispenser shall be interlocked with the batching and discharging operation of the water so that each admixture is separately batched and individually discharged automatically in a manner to obtain uniform distribution throughout the water as it is added to the batch in the specified mixing period. When use of truck mixers makes this requirement impractical, the admixture dispensers shall be interlocked with the sand batchers. Different admixtures shall not be combined prior to introduction in water and shall not be allowed to intermingle until in contact with the cement. Admixture dispensers shall have suitable devices to detect and indicate flow during dispensing or have a means for visual observation. The plant shall be arranged so as to facilitate the inspection of all operations at all times. Suitable facilities shall be provided for obtaining representative samples of aggregates from each bin or compartment, and for sampling and calibrating the dispensing of cementitious material, water, and admixtures. Filling ports for cementitious materials bins or silos shall be clearly marked with a permanent sign stating the contents.

#### 3.2.1.3 Scales

The weighing equipment shall conform to the applicable requirements of CPMB Concrete Plant Standard, and of NIST HB 44, except that the accuracy shall be plus or minus 0.2 percent of scale capacity. The Contractor shall provide standard test weights and any other auxiliary equipment required for checking the operating performance of each scale or other measuring devices. The tests shall be made at the specified frequency in the presence of a Government inspector. The weighing equipment shall be arranged so that the plant operator can conveniently observe all dials or indicators.

#### 3.2.1.4 Batching Tolerances

##### (A) Tolerances with Weighing Equipment

MATERIAL	PERCENT OF REQUIRED WEIGHT
Cementitious materials	0 to plus 2
Aggregate	plus or minus 2
Water	plus or minus 1
Chemical admixture	0 to plus 6

##### (B) Tolerances with Volumetric Equipment

For volumetric batching equipment used for water and admixtures, the following tolerances shall apply to the required volume of material being batched:

MATERIAL	PERCENT OF REQUIRED MATERIAL
Water:	plus or minus 1 percent
Chemical admixtures:	0 to plus 6 percent

#### 3.2.1.5 Moisture Control

The plant shall be capable of ready adjustment to compensate for the varying moisture content of the aggregates and to change the weights of the materials being batched.

#### 3.2.1.6 Concrete Mixers

Mixers shall be stationary mixers or truck mixers. Mixers shall be capable of combining the materials into a uniform mixture and of discharging this mixture without segregation. The mixers shall not be charged in excess of the capacity recommended by the manufacturer. The mixers shall be operated at the drum or mixing blade speed designated by the manufacturer. The mixers shall be maintained in satisfactory operating condition, and the mixer drums shall be kept free of hardened concrete. Should any mixer at any time produce unsatisfactory results, its use shall be promptly discontinued until it is repaired.

#### 3.2.1.7 Stationary Mixers

Concrete plant mixers shall be drum-type mixers of tilting, nontilting, horizontal-shaft, or vertical-shaft type, or shall be pug mill type and shall be provided with an acceptable device to lock the discharge mechanism until the required mixing time has elapsed. The mixing time and uniformity shall conform to all the requirements in ASTM C 94/C 94M applicable to central-mixed concrete.

#### 3.2.1.8 Truck Mixers

Truck mixers, the mixing of concrete therein, and concrete uniformity shall conform to the requirements of ASTM C 94/C 94M. A truck mixer may be used either for complete mixing (transit-mixed) or to finish the partial mixing done in a stationary mixer (shrink-mixed). Each truck shall be equipped with two counters from which it is possible to determine the number of revolutions at mixing speed and the number of revolutions at agitating speed. Or, if approved in lieu of this, the number of revolutions shall be marked on the batch tickets. Water shall not be added at the placing site unless specifically approved; and in no case shall it exceed the specified w/c. Any such water shall be injected at the base of the mixer, not at the discharge end.

### 3.3 LIGHTWEIGHT AGGREGATE CONCRETE

In addition to the requirements specified for normal weight concrete, lightweight aggregate concrete shall conform to the following. The batching and mixing cycle shall be as directed based on written recommendations from the aggregate supplier which the Contractor shall furnish. Unless otherwise directed, the mixer shall be charged with approximately 2/3 of the total mixing water and all of the aggregate. This shall be mixed for at least 1-1/2 minutes in a stationary mixer or 15 revolutions at mixing speed in a truck mixer. The remaining ingredients shall then be added and mixing continued as specified for normal weight concrete. Lightweight aggregate concrete shall not be vibrated to the extent that large particles of aggregate float to the surface. During finishing, lightweight aggregate concrete shall not be worked to the extent that mortar is driven down and lightweight coarse aggregate appears at the surface. Lightweight aggregate concrete to be pumped shall have a cement content of at least 335 kg per cubic meter. A field trial run of lightweight aggregate concrete placement and finishing shall be made in accordance with ACI 213R.

### 3.4 TRANSPORTING CONCRETE TO PROJECT SITE

Concrete shall be transported to the placing site in truck mixers,.

### 3.5 CONVEYING CONCRETE ON SITE

Concrete shall be conveyed from mixer or transporting unit to forms as rapidly as possible and within the time interval specified by methods which will prevent segregation or loss of ingredients using following equipment. Conveying equipment shall be cleaned before each placement.

#### 3.5.1 Buckets

The interior hopper slope shall be not less than 58 degrees from the horizontal, the minimum dimension of the clear gate opening shall be at least 5 times the nominal maximum-size aggregate, and the area of the gate opening shall not be less than 0.2 square meters. The maximum dimension of the gate opening shall not be greater than twice the minimum dimension. The bucket gates shall be essentially grout tight when closed and may be manually, pneumatically, or hydraulically operated except that buckets larger than 1.5 cubic meters shall not be manually operated. The design of the bucket shall provide means for positive regulation of the amount and rate of deposit of concrete in each dumping position.

#### 3.5.2 Transfer Hoppers

Concrete may be charged into nonagitating hoppers for transfer to other conveying devices. Transfer hoppers shall be capable of receiving concrete directly from delivery vehicles and shall have conical-shaped discharge features. The transfer hopper shall be equipped with a hydraulically operated gate and with a means of external vibration to effect complete discharge. Concrete shall not be held in nonagitating transfer hoppers more than 30 minutes.

#### 3.5.3 Trucks

Truck mixers operating at agitating speed or truck agitators used for transporting plant-mixed concrete shall conform to the requirements of ASTM C 94/C 94M. Nonagitating equipment shall be used only for transporting plant-mixed concrete over a smooth road and when the hauling time is less than 15 minutes. Bodies of nonagitating equipment shall be smooth, watertight, metal containers specifically designed to transport concrete, shaped with rounded corners to minimize segregation, and equipped with gates that will permit positive control of the discharge of the concrete.

#### 3.5.4 Chutes

When concrete can be placed directly from a truck mixer, agitator, or nonagitating equipment, the chutes normally attached to this equipment by the manufacturer may be used. A discharge deflector shall be used when required by the Contracting Officer. Separate chutes and other similar equipment will not be permitted for conveying concrete.

#### 3.5.5 Belt Conveyors

Belt conveyors shall be designed and operated to assure a uniform flow of concrete from mixer to final place of deposit without segregation of ingredients or loss of mortar and shall be provided with positive means,

such as discharge baffle or hopper , for preventing segregation of the concrete at the transfer points and the point of placing. Belt conveyors shall be constructed such that the idler spacing shall not exceed 900 mm. The belt speed shall be a minimum of 90 meters per minute and a maximum of 225 meters per minute. If concrete is to be placed through installed horizontal or sloping reinforcing bars, the conveyor shall discharge concrete into a pipe or elephant truck that is long enough to extend through the reinforcing bars.

### 3.5.6 Concrete Pumps

Concrete may be conveyed by positive displacement pump when approved. The pumping equipment shall be piston or squeeze pressure type; pneumatic placing equipment shall not be used. The pipeline shall be rigid steel pipe or heavy-duty flexible hose. The inside diameter of the pipe shall be at least 3 times the nominal maximum-size coarse aggregate in the concrete mixture to be pumped but not less than 100 mm. Aluminum pipe shall not be used.

## 3.6 PLACING CONCRETE

Mixed concrete shall be discharged within 1-1/2 hours or before the mixer drum has revolved 300 revolutions, whichever comes first after the introduction of the mixing water to the cement and aggregates. When the concrete temperature exceeds 30 degrees C, the time shall be reduced to 45 minutes. Concrete shall be placed within 15 minutes after it has been discharged from the transporting unit. Concrete shall be handled from mixer or transporting unit to forms in a continuous manner until the approved unit of operation is completed. Adequate scaffolding, ramps and walkways shall be provided so that personnel and equipment are not supported by in-place reinforcement. Placing will not be permitted when the sun, heat, wind, or limitations of facilities furnished by the Contractor prevent proper consolidation, finishing and curing. Sufficient placing capacity shall be provided so that concrete can be kept free of cold joints.

### 3.6.1 Depositing Concrete

Concrete shall be deposited as close as possible to its final position in the forms, and there shall be no vertical drop greater than 1.5 meters except where suitable equipment is provided to prevent segregation and where specifically authorized. Depositing of the concrete shall be so regulated that it will be effectively consolidated in horizontal layers not more than 300 mm thick, except that all slabs shall be placed in a single layer. Concrete to receive other construction shall be screeded to the proper level. Concrete shall be deposited continuously in one layer or in layers so that fresh concrete is deposited on in-place concrete that is still plastic. Fresh concrete shall not be deposited on concrete that has hardened sufficiently to cause formation of seams or planes of weakness within the section. Concrete that has surface dried, partially hardened, or contains foreign material shall not be used. When temporary spreaders are used in the forms, the spreaders shall be removed as their service becomes unnecessary. Concrete shall not be placed in slabs over columns and walls until concrete in columns and walls has been in-place at least two hours or until the concrete begins to lose its plasticity. Concrete for beams, girders, brackets, column capitals, haunches, and drop panels shall be placed at the same time as concrete for adjoining slabs.

### 3.6.2 Consolidation

Immediately after placing, each layer of concrete shall be consolidated by internal vibrators, except for slabs 100 mm thick or less. The vibrators shall at all times be adequate in effectiveness and number to properly consolidate the concrete; a spare vibrator shall be kept at the jobsite during all concrete placing operations. The vibrators shall have a frequency of not less than 10,000 vibrations per minute, an amplitude of at least 0.6 mm, and the head diameter shall be appropriate for the structural member and the concrete mixture being placed. Vibrators shall be inserted vertically at uniform spacing over the area of placement. The distance between insertions shall be approximately 1-1/2 times the radius of action of the vibrator so that the area being vibrated will overlap the adjacent just-vibrated area by a reasonable amount. The vibrator shall penetrate rapidly to the bottom of the layer and at least 150 mm into the preceding layer if there is such. Vibrator shall be held stationary until the concrete is consolidated and then vertically withdrawn slowly while operating. Form vibrators shall not be used unless specifically approved and unless forms are constructed to withstand their use. Vibrators shall not be used to move concrete within the forms. Slabs 100 mm and less in thickness shall be consolidated by properly designed vibrating screeds or other approved technique. Excessive vibration of lightweight concrete resulting in segregation or flotation of coarse aggregate shall be prevented.

Frequency and amplitude of vibrators shall be determined in accordance with COE CRD-C 521. Grate tampers ("jitterbugs") shall not be used.

### 3.6.3 Cold Weather Requirements

Special protection measures, approved by the Contracting Officer, shall be used if freezing temperatures are anticipated before the expiration of the specified curing period. The ambient temperature of the air where concrete is to be placed and the temperature of surfaces to receive concrete shall be not less than 5 degrees C. The temperature of the concrete when placed shall be not less than 10 degrees C nor more than 25 degrees C. Heating of the mixing water or aggregates will be required to regulate the concrete placing temperature. Materials entering the mixer shall be free from ice, snow, or frozen lumps. Salt, chemicals or other materials shall not be incorporated in the concrete to prevent freezing. Upon written approval, an accelerating admixture conforming to ASTM C 494/C 494M, Type C or E may be used, provided it contains no calcium chloride. Calcium chloride shall not be used.

### 3.6.4 Hot Weather Requirements

When the ambient temperature during concrete placing is expected to exceed 30 degrees C, the concrete shall be placed and finished with procedures previously submitted and as specified herein. The concrete temperature at time of delivery to the forms shall not exceed the temperature shown in the table below when measured in accordance with ASTM C 1064/C 1064M. Cooling of the mixing water or aggregates or placing concrete in the cooler part of the day may be required to obtain an adequate placing temperature. A retarder may be used, as approved, to facilitate placing and finishing. Steel forms and reinforcements shall be cooled as approved prior to concrete placement when steel temperatures are greater than 49 degrees C. Conveying and placing equipment shall be cooled if necessary to maintain proper concrete-placing temperature.



### Maximum Allowable Concrete Placing Temperature

Relative Humidity, Percent, During Time of Concrete Placement	Maximum Allowable Concrete Temperature Degrees
Greater than 60	33 C
40-60	30 C
Less than 40	27 C

#### 3.6.5 Prevention of Plastic Shrinkage Cracking

During hot weather with low humidity, and particularly with appreciable wind, as well as interior placements when space heaters produce low humidity, the Contractor shall be alert to the tendency for plastic shrinkage cracks to develop and shall institute measures to prevent this. Particular care shall be taken if plastic shrinkage cracking is potentially imminent and especially if it has developed during a previous placement. Periods of high potential for plastic shrinkage cracking can be anticipated by use of Fig. 2.1.5 of ACI 305R. In addition the concrete placement shall be further protected by erecting shades and windbreaks and by applying fog sprays of water, sprinkling, ponding or wet covering. Plastic shrinkage cracks that occur shall be filled by injection of epoxy resin as directed, after the concrete hardens. Plastic shrinkage cracks shall never be troweled over or filled with slurry.

#### 3.6.6 Placing Concrete in Congested Areas

Special care shall be used to ensure complete filling of the forms, elimination of all voids, and complete consolidation of the concrete when placing concrete in areas congested with reinforcing bars, embedded items, waterstops and other tight spacing. An appropriate concrete mixture shall be used, and the nominal maximum size of aggregate (NMSA) shall meet the specified criteria when evaluated for the congested area. Vibrators with heads of a size appropriate for the clearances available shall be used, and the consolidation operation shall be closely supervised to ensure complete and thorough consolidation at all points. Where necessary, splices of reinforcing bars shall be alternated to reduce congestion. Where two mats of closely spaced reinforcing are required, the bars in each mat shall be placed in matching alignment to reduce congestion. Reinforcing bars may be temporarily crowded to one side during concrete placement provided they are returned to exact required location before concrete placement and consolidation are completed.

#### 3.6.7 Placing Flowable Concrete

If a plasticizing admixture conforming to ASTM C 1017/C 1017M is used or if a Type F or G high range water reducing admixture is permitted to increase the slump, the concrete shall meet all requirements of paragraph GENERAL REQUIREMENTS in PART 1. Extreme care shall be used in conveying and placing the concrete to avoid segregation. Consolidation and finishing shall meet all requirements of paragraphs Placing Concrete, Finishing Formed Surfaces, and Finishing Unformed Surfaces. No relaxation of requirements to accommodate flowable concrete will be permitted.

#### 3.7 JOINTS

Joints shall be located and constructed as indicated or approved. Joints not indicated on the drawings shall be located and constructed to minimize the impact on the strength of the structure. In general, such joints shall be located near the middle of the spans of supported slabs, beams, and girders unless a beam intersects a girder at this point, in which case the joint in the girder shall be offset a distance equal to twice the width of the beam. Joints in walls and columns shall be at the underside of floors, slabs, beams, or girders and at the tops of footings or floor slabs, unless otherwise approved. Joints shall be perpendicular to the main reinforcement. All reinforcement shall be continued across joints; except that reinforcement or other fixed metal items shall not be continuous through expansion joints, or through construction or contraction joints in slabs on grade. Reinforcement shall be 50 mm clear from each joint. Except where otherwise indicated, construction joints between interior slabs on grade and vertical surfaces shall consist of 1.5 kg per square meter asphalt-saturated felt, extending for the full depth of the slab. The perimeters of the slabs shall be free of fins, rough edges, spalling, or other unsightly appearance. Reservoir for sealant for construction and contraction joints in slabs shall be formed to the dimensions shown on the drawings by removing snap-out joint-forming inserts, by sawing sawable inserts, or by sawing to widen the top portion of sawed joints. Joints to be sealed shall be cleaned and sealed as indicated and in accordance with Section 07900 JOINT SEALING.

### 3.7.1 Construction Joints

For concrete other than slabs on grade, construction joints shall be located so that the unit of operation does not exceed 18 meters. Concrete shall be placed continuously so that each unit is monolithic in construction. Fresh concrete shall not be placed against adjacent hardened concrete until it is at least 24 hours old. Construction joints shall be located as indicated or approved. Where concrete work is interrupted by weather, end of work shift or other similar type of delay, location and type of construction joint shall be subject to approval of the Contracting Officer. Unless otherwise indicated and except for slabs on grade, reinforcing steel shall extend through construction joints. Construction joints in slabs on grade shall be keyed or doweled as shown. Concrete columns, walls, or piers shall be in place at least 2 hours, or until the concrete begins to lose its plasticity, before placing concrete for beams, girders, or slabs thereon. In walls having door or window openings, lifts shall terminate at the top and bottom of the opening. Other lifts shall terminate at such levels as to conform to structural requirements or architectural details. Where horizontal construction joints in walls or columns are required, a strip of 25 mmsquare-edge lumber, bevelled and oiled to facilitate removal, shall be tacked to the inside of the forms at the construction joint. Concrete shall be placed to a point 25 mm above the underside of the strip. The strip shall be removed 1 hour after the concrete has been placed, and any irregularities in the joint line shall be leveled off with a wood float, and all laitance shall be removed. Prior to placing additional concrete, horizontal construction joints shall be prepared as specified in paragraph Previously Placed Concrete.

### 3.7.2 Contraction Joints in Slabs on Grade

Contraction joints shall be located and detailed as shown on the drawings. Contraction Joints shall be produced by forming a weakened plane in the concrete slab by use of rigid inserts impressed in the concrete during placing operations, use of snap-out plastic joint forming inserts or sawing

a continuous slot with a concrete saw. Regardless of method used to produce the weakened plane, it shall be 1/4 the depth of the slab thickness and between 3 and 5 mm wide. For saw-cut joints, cutting shall be timed properly with the set of the concrete. Cutting shall be started as soon as the concrete has hardened sufficiently to prevent raveling of the edges of the saw cut. Cutting shall be completed before shrinkage stresses become sufficient to produce cracking. Reservoir for joint sealant shall be formed as previously specified.

### 3.7.3 Expansion Joints

Installation of expansion joints and sealing of these joints shall conform to the requirements of Section 03150 EXPANSION JOINTS, CONTRACTION JOINTS, AND WATERSTOPS and Section 07900 JOINT SEALING.

### 3.7.4 Waterstops

Waterstops shall be installed in conformance with the locations and details shown on the drawings using materials and procedures specified in Section 03150 EXPANSION JOINTS, CONTRACTION JOINTS, AND WATERSTOPS.

### 3.7.5 Dowels and Tie Bars

Dowels and tie bars shall be installed at the locations shown on the drawings and to the details shown, using materials and procedures specified in Section 03200 CONCRETE REINFORCEMENT and herein. Conventional smooth "paving" dowels shall be installed in slabs using approved methods to hold the dowel in place during concreting within a maximum alignment tolerance of 1 mm in 100 mm. "Structural" type deformed bar dowels, or tie bars, shall be installed to meet the specified tolerances. Care shall be taken during placing adjacent to and around dowels and tie bars to ensure there is no displacement of the dowel or tie bar and that the concrete completely embeds the dowel or tie bar and is thoroughly consolidated.

## 3.8 FINISHING FORMED SURFACES

Forms, form materials, and form construction are specified in Section 03100 STRUCTURAL CONCRETE FORMWORK. Finishing of formed surfaces shall be as specified herein. Unless another type of architectural or special finish is specified, surfaces shall be left with the texture imparted by the forms except that defective surfaces shall be repaired. Unless painting of surfaces is required, uniform color of the concrete shall be maintained by use of only one mixture without changes in materials or proportions for any structure or portion of structure that requires a Class A or B finish. Except for major defects, as defined hereinafter, surface defects shall be repaired as specified herein within 24 hours after forms are removed. Repairs of the so-called "plaster-type" will not be permitted in any location. Tolerances of formed surfaces shall conform to the requirements of ACI 117/117R. These tolerances apply to the finished concrete surface, not to the forms themselves; forms shall be set true to line and grade. Form tie holes requiring repair and other defects whose depth is at least as great as their surface diameter shall be repaired as specified in paragraph Damp-Pack Mortar Repair. Defects whose surface diameter is greater than their depth shall be repaired as specified in paragraph Repair of Major Defects. Repairs shall be finished flush with adjacent surfaces and with the same surface texture. The cement used for all repairs shall be a blend of job cement with white cement proportioned so that the final color after curing and aging will be the same as the adjacent concrete. Concrete with excessive honeycomb, or other defects which affect the

strength of the member, will be rejected. Repairs shall be demonstrated to be acceptable and free from cracks or loose or drummy areas at the completion of the contract and, for Class A and B Finishes, shall be inconspicuous. Repairs not meeting these requirements will be rejected and shall be replaced.

### 3.8.1 Class A Finish and Class B Finish

Class A finish is required on interior surfaces exposed to view. Class B finish is required on exterior surfaces exposed to view. Fins, ravelings, and loose material shall be removed, all surface defects over 12 mm in diameter or more than 12 mm deep, shall be repaired and, except as otherwise indicated or as specified in Section 03100 STRUCTURAL CONCRETE FORMWORK, holes left by removal of form ties shall be reamed and filled. Defects more than 12 mm in diameter shall be cut back to sound concrete, but in all cases at least 25 mm deep. The Contractor shall prepare a sample panel for approval (as specified in PART 1) before commencing repair, showing that the surface texture and color match will be attained. Metal tools shall not be used to finish repairs in Class A surfaces.

### 3.8.2 Class C and Class D Finish

Class C finish is required on surfaces not exposed to view, unless noted otherwise. Class D finish is allowed only where indicated on the drawings.

Fins, ravelings, and loose material shall be removed, and, except as otherwise indicated or as specified in Section 03100 STRUCTURAL CONCRETE FORMWORK, holes left by removal of form ties shall be reamed and filled. Honeycomb and other defects more than 12 mm deep or more than 50 mm in diameter shall be repaired. Defects more than 50 mm in diameter shall be cut back to sound concrete, but in all cases at least 25 mm deep.

## 3.9 REPAIRS

### 3.9.1 Damp-Pack Mortar Repair

Form tie holes requiring repair and other defects whose depth is at least as great as their surface diameter but not over 100 mm shall be repaired by the damp-pack mortar method. Form tie holes shall be reamed and other similar defects shall be cut out to sound concrete. The void shall then be thoroughly cleaned, thoroughly wetted, brush-coated with a thin coat of neat cement grout and filled with mortar. Mortar shall be a stiff mix of 1 part portland cement to 2 parts fine aggregate passing the 1.18 mm sieve, and minimum amount of water. Only sufficient water shall be used to produce a mortar which, when used, will stick together on being molded into a ball by a slight pressure of the hands and will not exude water but will leave the hands damp. Mortar shall be mixed and allowed to stand for 30 to 45 minutes before use with remixing performed immediately prior to use. Mortar shall be thoroughly tamped in place in thin layers using a hammer and hardwood block. Holes passing entirely through walls shall be completely filled from the inside face by forcing mortar through to the outside face. All holes shall be packed full. Damp-pack repairs shall be moist cured for at least 48 hours.

### 3.9.2 Repair of Major Defects

Major defects will be considered to be those more than 12 mm deep or, for Class A and B finishes, more than 12 mm in diameter and, for Class C and D finishes, more than 50 mm in diameter. Also included are any defects of any kind whose depth is over 100 mm or whose surface diameter is greater

than their depth. Major defects shall be repaired as specified below.

#### 3.9.2.1 Surface Application of Mortar Repair

Defective concrete shall be removed, and removal shall extend into completely sound concrete. Approved equipment and procedures which will not cause cracking or microcracking of the sound concrete shall be used. If reinforcement is encountered, concrete shall be removed so as to expose the reinforcement for at least 50 mm on all sides. All such defective areas greater than 7800 square mm shall be outlined by saw cuts at least 25 mm deep. Defective areas less than 7800 square mm shall be outlined by a 25 mm deep cut with a core drill in lieu of sawing. All saw cuts shall be straight lines in a rectangular pattern in line with the formwork panels. After concrete removal, the surface shall be thoroughly cleaned by high pressure washing to remove all loose material. Surfaces shall be kept continually saturated for the first 12 of the 24 hours immediately before placing mortar and shall be damp but not wet at the time of commencing mortar placement. The Contractor, at his option, may use either hand-placed mortar or mortar placed with a mortar gun. If hand-placed mortar is used, the edges of the cut shall be perpendicular to the surface of the concrete. The prepared area shall be brush-coated with a thin coat of neat cement grout. The repair shall then be made using a stiff mortar, preshrunk by allowing the mixed mortar to stand for 30 to 45 minutes and then remixed, thoroughly tamped into place in thin layers. If hand-placed mortar is used, the Contractor shall test each repair area for drumminess by firm tapping with a hammer and shall inspect for cracks, both in the presence of the Contracting Officer's representative, immediately before completion of the contract, and shall replace any showing drumminess or cracking. If mortar placed with a mortar gun is used, the gun shall be a small compressed air-operated gun to which the mortar is slowly hand fed and which applies the mortar to the surface as a high-pressure stream, as approved. Repairs made using shotcrete equipment will not be accepted. The mortar used shall be the same mortar as specified for damp-pack mortar repair. If gun-placed mortar is used, the edges of the cut shall be beveled toward the center at a slope of 1:1. All surface applied mortar repairs shall be continuously moist cured for at least 7 days. Moist curing shall consist of several layers of saturated burlap applied to the surface immediately after placement is complete and covered with polyethylene sheeting, all held closely in place by a sheet of plywood or similar material rigidly braced against it. Burlap shall be kept continually wet.

#### 3.9.2.2 Repair of Deep and Large Defects

Deep and large defects will be those that are more than 150 mm deep and also have an average diameter at the surface more than 450 mm or that are otherwise so identified by the Project Office. Such defects shall be repaired as specified herein or directed, except that defects which affect the strength of the structure shall not be repaired and that portion of the structure shall be completely removed and replaced. Deep and large defects shall be repaired by procedures approved in advance including forming and placing special concrete using applied pressure during hardening. Preparation of the repair area shall be as specified for surface application of mortar. In addition, the top edge (surface) of the repair area shall be sloped at approximately 20 degrees from the horizontal, upward toward the side from which concrete will be placed. The special concrete shall be a concrete mixture with low water content and low slump, and shall be allowed to age 30 to 60 minutes before use. Concrete containing a specified expanding admixture may be used in lieu of the above

mixture; the paste portion of such concrete mixture shall be designed to have an expansion between 2.0 and 4.0 percent when tested in accordance with ASTM C 940. A full width "chimney" shall be provided at the top of the form on the placing side to ensure filling to the top of the opening. A pressure cap shall be used on the concrete in the chimney with simultaneous tightening and revibrating the form during hardening to ensure a tight fit for the repair. The form shall be removed after 24 hours and immediately the chimney shall be carefully chipped away to avoid breaking concrete out of the repair; the surface of the repair concrete shall be dressed as required.

### 3.10 FINISHING UNFORMED SURFACES

The finish of all unformed surfaces shall meet the requirements of paragraph Tolerances in PART 1, when tested as specified herein.

#### 3.10.1 General

The ambient temperature of spaces adjacent to unformed surfaces being finished and of the base on which concrete will be placed shall be not less than 10 degrees C. In hot weather all requirements of paragraphs Hot Weather Requirements and Prevention of Plastic Shrinkage Cracking shall be met. Unformed surfaces that are not to be covered by additional concrete or backfill shall have a float finish, with additional finishing as specified below, and shall be true to the elevation shown on the drawings. Surfaces to receive additional concrete or backfill shall be brought to the elevation shown on the drawings, properly consolidated, and left true and regular. Unless otherwise shown on the drawings, exterior surfaces shall be sloped for drainage, as directed. Where drains are provided, interior floors shall be evenly sloped to the drains. Joints shall be carefully made with a jointing or edging tool. The finished surfaces shall be protected from stains or abrasions. Grate tampers or "jitterbugs" shall not be used for any surfaces. The dusting of surfaces with dry cement or other materials or the addition of any water during finishing shall not be permitted. If bleedwater is present prior to finishing, the excess water shall be carefully dragged off or removed by absorption with porous materials such as burlap. During finishing operations, extreme care shall be taken to prevent over finishing or working water into the surface; this can cause "crazing" (surface shrinkage cracks which appear after hardening) of the surface. Any slabs with surfaces which exhibit significant crazing shall be removed and replaced. During finishing operations, surfaces shall be checked with a 10 foot straightedge, applied in both directions at regular intervals while the concrete is still plastic, to detect high or low areas.

#### 3.10.2 Rough Slab Finish

As a first finishing operation for unformed surfaces and as final finish for slabs to receive mortar setting beds, the surface shall receive a rough slab finish prepared as follows. Areas which receive a thick mortar setting bed shall receive only a rough slab finish. The concrete shall be uniformly placed across the slab area, consolidated as previously specified, and then screeded with straightedge strikeoffs immediately after consolidation to bring the surface to the required finish level with no coarse aggregate visible. Side forms and screed rails shall be provided, rigidly supported, and set to exact line and grade. Allowable tolerances for finished surfaces apply only to the hardened concrete, not to forms or screed rails. Forms and screed rails shall be set true to line and grade. "Wet screeds" shall not be used. The garage floor shall have a screeded

finish.

### 3.10.3 Floated Finish

Slabs to receive more than a rough slab finish shall next be given a wood float finish. The screeding shall be followed immediately by darbying or bull floating before bleeding water is present, to bring the surface to a true, even plane. Then, after the concrete has stiffened so that it will withstand a man's weight without imprint of more than 6 mm and the water sheen has disappeared, it shall be floated to a true and even plane free of ridges. Floating shall be performed by use of suitable hand floats or power driven equipment. Sufficient pressure shall be used on the floats to bring a film of moisture to the surface. Hand floats shall be made of wood, magnesium, or aluminum. Lightweight concrete or concrete that exhibits stickiness shall be floated with a magnesium float. Care shall be taken to prevent over-finishing or incorporating water into the surface.

### 3.10.4 Troweled Finish

All slabs shall be given a trowel finish unless noted otherwise. After floating is complete and after the surface moisture has disappeared, unformed surfaces shall be steel-troweled to a smooth, even, dense finish, free from blemishes including trowel marks. In lieu of hand finishing, an approved power finishing machine may be used in accordance with the directions of the machine manufacturer. Additional trowelings shall be performed, either by hand or machine until the surface has been troweled 2 times, with waiting period between each. Care shall be taken to prevent blistering and if such occurs, troweling shall immediately be stopped and operations and surfaces corrected. A final hard steel troweling shall be done by hand, with the trowel tipped, and using hard pressure, when the surface is at a point that the trowel will produce a ringing sound. The finished surface shall be thoroughly consolidated and shall be essentially free of trowel marks and be uniform in texture and appearance. The concrete mixture used for troweled finished areas shall be adjusted, if necessary, in order to provide sufficient fines (cementitious material and fine sand) to finish properly.

### 3.10.5 Non-Slip Finish

Non-slip floors shall be constructed in accordance with the following subparagraphs.

#### 3.10.5.1 Broomed

Exterior sloops, landings, sidewalks, and entrances shall be given a broomed finish. After floating, the surface shall be lightly steel troweled, and then carefully scored by pulling a coarse fiber push-type broom across the surface. Brooming shall be transverse to traffic or at right angles to the slope of the slab. After the end of the curing period, the surface shall be vigorously broomed with a coarse fiber broom to remove all loose or semi-detached particles.

## 3.11 EXTERIOR SLAB AND RELATED ITEMS

### 3.11.1 Pavements

Pavements shall be constructed where shown on the drawings. After forms are set and underlying material prepared as specified, the concrete shall be placed uniformly throughout the area and thoroughly vibrated. As soon

as placed and vibrated, the concrete shall be struck off and screeded to the crown and cross section and to such elevation above grade that when consolidated and finished, the surface of the pavement will be at the required elevation. The entire surface shall be tamped with the strike off, or consolidated with a vibrating screed, and this operation continued until the required compaction and reduction of internal and surface voids are accomplished. Care shall be taken to prevent bringing excess paste to the surface. Immediately following the final consolidation of the surface, the pavement shall be floated longitudinally from bridges resting on the side forms and spanning but not touching the concrete. If necessary, additional concrete shall be placed and screeded, and the float operated until a satisfactory surface has been produced. The floating operation shall be advanced not more than half the length of the float and then continued over the new and previously floated surfaces. After finishing is completed but while the concrete is still plastic, minor irregularities and score marks in the pavement surface shall be eliminated by means of long-handled cutting straightedges. Straightedges shall be 3.75 m in length and shall be operated from the sides of the pavement and from bridges. A straightedge operated from the side of the pavement shall be equipped with a handle 1 m longer than one-half the width of the pavement. The surface shall then be tested for trueness with a 3.75 straightedge held in successive positions parallel and at right angles to the center line of the pavement, and the whole area covered as necessary to detect variations. The straightedge shall be advanced along the pavement in successive stages of not more than one-half the length of the straightedge. Depressions shall be immediately filled with freshly mixed concrete, struck off, consolidated, and refinished. Projections above the required elevation shall also be struck off and refinished. The straightedge testing and finishing shall continue until the entire surface of the concrete is true. Before the surface sheen has disappeared and well before the concrete becomes nonplastic, the surface of the pavement shall be given a nonslip sandy surface texture by use of a burlap drag. A strip of clean, wet burlap from 1.0 to 1.5 m wide and 0.7 m longer than the pavement width shall be carefully pulled across the surface. Edges and joints shall be rounded with an edger having a radius of 3 mm. Curing shall be as specified.

#### 3.11.2 Sidewalks

Concrete shall be 100 mm minimum thickness. Contraction joints shall be provided at 1.75 m spaces unless otherwise indicated. Contraction joints shall be cut 25 mm deep with a jointing tool after the surface has been finished. Transverse expansion joints 12 mm thick shall be provided at changes in direction and where sidewalk abuts curbs, steps, rigid pavement, or other similar structures. Sidewalks shall be given a lightly broomed finish. A transverse slope of 1 mm per 50 mm shall be provided, unless otherwise indicated. Variations in cross section shall be limited to 1 mm per 250 mm.

#### 3.11.3 Curbs and Gutters

Concrete shall be formed, placed, and finished by hand using a properly shaped "mule" or constructed using a slipform machine specially designed for this work. Contraction joints shall be cut 75 mm deep with a jointing tool after the surface has been finished. Expansion joints (12 mm wide) shall be provided at 35 m maximum spacing unless otherwise indicated. Exposed surfaces shall be finished using a stiff bristled brush.

#### 3.11.4 Pits and Trenches



Pits and trenches shall be constructed as indicated on the drawings. Bottoms and walls shall be placed monolithically or waterstops and keys, shall be provided as approved.

### 3.12 CURING AND PROTECTION

#### 3.12.1 General

Concrete shall be cured by an approved method for the period of time given below:

Concrete with Type III cement	3 days
All other concrete	7 days

Immediately after placement, concrete shall be protected from premature drying, extremes in temperatures, rapid temperature change, mechanical injury and damage from rain and flowing water for the duration of the curing period. Air and forms in contact with concrete shall be maintained at a temperature above 10 degrees C for the first 3 days and at a temperature above 0 degrees C for the remainder of the specified curing period. Exhaust fumes from combustion heating units shall be vented to the outside of the enclosure, and heaters and ducts shall be placed and directed so as not to cause areas of overheating and drying of concrete surfaces or to create fire hazards. Materials and equipment needed for adequate curing and protection shall be available and at the site prior to placing concrete. No fire or excessive heat, including welding, shall be permitted near or in direct contact with the concrete at any time. Except as otherwise permitted by paragraph Membrane Forming Curing Compounds, moist curing shall be provided for any areas to receive floor hardener, any paint or other applied coating, or to which other concrete is to be bonded.

Concrete containing silica fume shall be initially cured by fog misting during finishing, followed immediately by continuous moist curing. Except for plastic coated burlap, impervious sheeting alone shall not be used for curing.

#### 3.12.2 Moist Curing

Concrete to be moist-cured shall be maintained continuously wet for the entire curing period, commencing immediately after finishing. If water or curing materials used stain or discolor concrete surfaces which are to be permanently exposed, the concrete surfaces shall be cleaned as approved. When wooden forms are left in place during curing, they shall be kept wet at all times. If steel forms are used in hot weather, nonsupporting vertical forms shall be broken loose from the concrete soon after the concrete hardens and curing water continually applied in this void. If the forms are removed before the end of the curing period, curing shall be carried out as on unformed surfaces, using suitable materials. Surfaces shall be cured by ponding, by continuous sprinkling, by continuously saturated burlap or cotton mats, or by continuously saturated plastic coated burlap. Burlap and mats shall be clean and free from any contamination and shall be completely saturated before being placed on the concrete. The Contractor shall have an approved work system to ensure that moist curing is continuous 24 hours per day.

#### 3.12.3 Ponding or Immersion

Concrete shall be continually immersed throughout the curing period. Water shall not be more than 10 degrees C less than the temperature of the concrete.

#### 3.12.4 Cold Weather Curing and Protection

When the daily ambient low temperature is less than 0 degrees C the temperature of the concrete shall be maintained above 5 degrees C for the first seven days after placing. During the period of protection removal, the air temperature adjacent to the concrete surfaces shall be controlled so that concrete near the surface will not be subjected to a temperature differential of more than 13 degrees C as determined by suitable temperature measuring devices furnished by either the Government or the Contractor at the Government's Option, as required, and installed adjacent to the concrete surface and 50 mm inside the surface of the concrete. The installation of the thermometers shall be made by the Contractor as directed.

#### 3.13 SETTING BASE PLATES AND BEARING PLATES

After being properly positioned, column base plates, bearing plates for beams and similar structural members, and machinery and equipment base plates shall be set to the proper line and elevation with damp-pack bedding mortar, except where nonshrink grout is indicated. The thickness of the mortar or grout shall be approximately 1/24 the width of the plate, but not less than 20 mm. Concrete and metal surfaces in contact with grout shall be clean and free of oil and grease, and concrete surfaces in contact with grout shall be damp and free of laitance when grout is placed. Nonshrink grout shall be used for column base plates and equipment bearing plates.

##### 3.13.1 Damp-Pack Bedding Mortar

Damp-pack bedding mortar shall consist of 1 part cement and 2-1/2 parts fine aggregate having water content such that a mass of mortar tightly squeezed in the hand will retain its shape but will crumble when disturbed.

The space between the top of the concrete and bottom of the bearing plate or base shall be packed with the bedding mortar by tamping or ramming with a bar or rod until it is completely filled.

##### 3.13.2 Nonshrink Grout

Nonshrink grout shall be a ready-mixed material requiring only the addition of water. Water content shall be the minimum that will provide a flowable mixture and completely fill the space to be grouted without segregation, bleeding, or reduction of strength.

##### 3.13.2.1 Mixing and Placing of Nonshrink Grout

Mixing and placing shall be in conformance with the material manufacturer's instructions and as specified therein. Ingredients shall be thoroughly dry-mixed before adding water. After adding water, the batch shall be mixed for 3 minutes. Batches shall be of size to allow continuous placement of freshly mixed grout. Grout not used within 30 minutes after mixing shall be discarded. The space between the top of the concrete or machinery-bearing surface and the plate shall be filled solid with the grout. Forms shall be of wood or other equally suitable material for completely retaining the grout on all sides and on top and shall be removed after the grout has set. The placed grout shall be carefully worked by rodding or other means to eliminate voids; however, overworking and breakdown of the initial set shall be avoided. Grout shall not be retempered or subjected to vibration from any source. Where clearances are unusually small, placement shall be under pressure with a grout pump.

Temperature of the grout, and of surfaces receiving the grout, shall be maintained at 18 to 30 degrees C until after setting.

#### 3.13.2.2 Treatment of Exposed Surfaces

For metal-oxidizing nonshrink grout, exposed surfaces shall be cut back 25 mm and immediately covered with a parge coat of mortar consisting of 1 part portland cement and 2-1/2 parts fine aggregate by weight, with sufficient water to make a plastic mixture. The parge coat shall have a smooth finish. For other mortars or grouts, exposed surfaces shall have a smooth-dense finish and be left untreated. Curing shall comply with paragraph CURING AND PROTECTION.

### 3.14 TESTING AND INSPECTION FOR CONTRACTOR QUALITY CONTROL

The Contractor shall perform the inspection and tests described below and, based upon the results of these inspections and tests, shall take the action required and shall submit specified reports. When, in the opinion of the Contracting Officer, the concreting operation is out of control, concrete placement shall cease and the operation shall be corrected. The laboratory performing the tests shall be onsite and shall conform with ASTM C 1077. Materials may be subjected to check testing by the Government from samples obtained at the manufacturer, at transfer points, or at the project site. The Government will inspect the laboratory, equipment, and test procedures prior to start of concreting operations and at least once per 380 m<sup>3</sup> thereafter for conformance with ASTM C 1077.

#### 3.14.1 Grading and Corrective Action

##### 3.14.1.1 Fine Aggregate

At least once during each shift when the concrete plant is operating, there shall be one sieve analysis and fineness modulus determination in accordance with ASTM C 136 and COE CRD-C 104 for the fine aggregate or for each fine aggregate if it is batched in more than one size or classification. The location at which samples are taken may be selected by the Contractor as the most advantageous for control. However, the Contractor is responsible for delivering fine aggregate to the mixer within specification limits. When the amount passing on any sieve is outside the specification limits, the fine aggregate shall be immediately resampled and retested. If there is another failure on any sieve, the fact shall immediately reported to the Contracting Officer, concreting shall be stopped, and immediate steps taken to correct the grading.

##### 3.14.1.2 Coarse Aggregate

At least once during each shift in which the concrete plant is operating, there shall be a sieve analysis in accordance with ASTM C 136 for each size of coarse aggregate. The location at which samples are taken may be selected by the Contractor as the most advantageous for production control. However, the Contractor shall be responsible for delivering the aggregate to the mixer within specification limits. A test record of samples of aggregate taken at the same locations shall show the results of the current test as well as the average results of the five most recent tests including the current test. The Contractor may adopt limits for control coarser than the specification limits for samples taken other than as delivered to the mixer to allow for degradation during handling. When the amount passing any sieve is outside the specification limits, the coarse aggregate shall be immediately resampled and retested. If the second sample fails on any

sieve, that fact shall be reported to the Contracting Officer. Where two consecutive averages of 5 tests are outside specification limits, the operation shall be considered out of control and shall be reported to the Contracting Officer. Concreting shall be stopped and immediate steps shall be taken to correct the grading.

#### 3.14.2 Quality of Aggregates

Thirty days prior to the start of concrete placement, the Contractor shall perform all tests for aggregate quality required by ASTM C 33. In addition, after the start of concrete placement, the Contractor shall perform tests for aggregate quality at least every three months, and when the source of aggregate or aggregate quality changes. Samples tested after the start of concrete placement shall be taken immediately prior to entering the concrete mixer.

#### 3.14.3 Scales, Batching and Recording

The accuracy of the scales shall be checked by test weights prior to start of concrete operations and at least once every three months. Such tests shall also be made as directed whenever there are variations in properties of the fresh concrete that could result from batching errors. Once a week the accuracy of each batching and recording device shall be checked during a weighing operation by noting and recording the required weight, recorded weight, and the actual weight batched. At the same time, the Contractor shall test and ensure that the devices for dispensing admixtures are operating properly and accurately. When either the weighing accuracy or batching accuracy does not comply with specification requirements, the plant shall not be operated until necessary adjustments or repairs have been made. Discrepancies in recording accuracies shall be corrected immediately.

#### 3.14.4 Batch-Plant Control

The measurement of concrete materials including cementitious materials, each size of aggregate, water, and admixtures shall be continuously controlled. The aggregate weights and amount of added water shall be adjusted as necessary to compensate for free moisture in the aggregates. The amount of air-entraining agent shall be adjusted to control air content within specified limits. A report shall be prepared indicating type and source of cement used, type and source of pozzolan or slag used, amount and source of admixtures used, aggregate source, the required aggregate and water weights per cubic meter, amount of water as free moisture in each size of aggregate, and the batch aggregate and water weights per cubic meter for each class of concrete batched during each day's plant operation.

#### 3.14.5 Concrete Mixture

- a. Air Content Testing. Air content tests shall be made when test specimens are fabricated. In addition, at least two tests for air content shall be made on randomly selected batches of each separate concrete mixture produced during each 8-hour period of concrete production. Additional tests shall be made when excessive variation in workability is reported by the placing foreman or Government inspector. Tests shall be made in accordance with ASTM C 231 for normal weight concrete and ASTM C 173 for lightweight concrete. Test results shall be plotted on control charts which shall at all times be readily available to the Government and shall be submitted weekly. Copies of the

current control charts shall be kept in the field by testing crews and results plotted as tests are made. When a single test result reaches either the upper or lower action limit, a second test shall immediately be made. The results of the two tests shall be averaged and this average used as the air content of the batch to plot on both the air content and the control chart for range, and for determining need for any remedial action. The result of each test, or average as noted in the previous sentence, shall be plotted on a separate control chart for each mixture on which an "average line" is set at the midpoint of the specified air content range from paragraph Air Entrainment. An upper warning limit and a lower warning limit line shall be set 1.0 percentage point above and below the average line, respectively. An upper action limit and a lower action limit line shall be set 1.5 percentage points above and below the average line, respectively. The range between each two consecutive tests shall be plotted on a secondary control chart for range where an upper warning limit is set at 2.0 percentage points and an upper action limit is set at 3.0 percentage points. Samples for air content may be taken at the mixer, however, the Contractor is responsible for delivering the concrete to the placement site at the stipulated air content. If the Contractor's materials or transportation methods cause air content loss between the mixer and the placement, correlation samples shall be taken at the placement site as required by the Contracting Officer, and the air content at the mixer controlled as directed.

- b. Air Content Corrective Action. Whenever points on the control chart for percent air reach either warning limit, an adjustment shall immediately be made in the amount of air-entraining admixture batched. As soon as practical after each adjustment, another test shall be made to verify the result of the adjustment. Whenever a point on the secondary control chart for range reaches the warning limit, the admixture dispenser shall be recalibrated to ensure that it is operating accurately and with good reproducibility. Whenever a point on either control chart reaches an action limit line, the air content shall be considered out of control and the concreting operation shall immediately be halted until the air content is under control. Additional air content tests shall be made when concreting is restarted.
- c. Slump Testing. In addition to slump tests which shall be made when test specimens are fabricated, at least four slump tests shall be made on randomly selected batches in accordance with ASTM C 143/C 143M for each separate concrete mixture produced during each 8-hour or less period of concrete production each day. Also, additional tests shall be made when excessive variation in workability is reported by the placing foreman or Government inspector. Test results shall be plotted on control charts which shall at all times be readily available to the Government and shall be submitted weekly. Copies of the current control charts shall be kept in the field by testing crews and results plotted as tests are made. When a single slump test reaches or goes beyond either the upper or lower action limit, a second test shall immediately be made. The results of the two tests shall be averaged and this average used as the slump of the batch to plot on both the control charts for slump and the chart for range, and for determining need for any remedial action. Limits shall be set on separate control charts for slump for each type of mixture.

The upper warning limit shall be set at 12.5 mm below the maximum allowable slump specified in paragraph Slump in PART 1 for each type of concrete and an upper action limit line and lower action limit line shall be set at the maximum and minimum allowable slumps, respectively, as specified in the same paragraph. The range between each consecutive slump test for each type of mixture shall be plotted on a single control chart for range on which an upper action limit is set at 50 mm. Samples for slump shall be taken at the mixer. However, the Contractor is responsible for delivering the concrete to the placement site at the stipulated slump. If the Contractor's materials or transportation methods cause slump loss between the mixer and the placement, correlation samples shall be taken at the placement site as required by the Contracting Officer, and the slump at the mixer controlled as directed.

- d. Slump Corrective Action. Whenever points on the control charts for slump reach the upper warning limit, an adjustment shall immediately be made in the batch weights of water and fine aggregate. The adjustments are to be made so that the total water content does not exceed that amount allowed by the maximum w/c ratio specified, based on aggregates which are in a saturated surface dry condition. When a single slump reaches the upper or lower action limit, no further concrete shall be delivered to the placing site until proper adjustments have been made. Immediately after each adjustment, another test shall be made to verify the correctness of the adjustment. Whenever two consecutive individual slump tests, made during a period when there was no adjustment of batch weights, produce a point on the control chart for range at or above the upper action limit, the concreting operation shall immediately be halted, and the Contractor shall take appropriate steps to bring the slump under control. Additional slump tests shall be made as directed.
- e. Temperature. The temperature of the concrete shall be measured when compressive strength specimens are fabricated. Measurement shall be in accordance with ASTM C 1064/C 1064M. The temperature shall be reported along with the compressive strength data.
- f. Strength Specimens. At least one set of test specimens shall be made, for compressive or flexural strength as appropriate, on each different concrete mixture placed during the day for each 380 cubic meters or portion thereof of that concrete mixture placed each day. Additional sets of test specimens shall be made, as directed by the Contracting Officer, when the mixture proportions are changed or when low strengths have been detected. A truly random (not haphazard) sampling plan shall be developed by the Contractor and approved by the Contracting Officer prior to the start of construction. The plan shall assure that sampling is done in a completely random and unbiased manner. A set of test specimens for concrete with a 28-day specified strength per paragraph Strength Requirements in PART 1 shall consist of four specimens, two to be tested at 7 days and two at 28 days. Test specimens shall be molded and cured in accordance with ASTM C 31/C 31M and tested in accordance with ASTM C 39/C 39M for test cylinders and ASTM C 78 for test beams. Results of all strength tests shall be reported immediately to the Contracting Officer. Quality control charts shall be kept for individual strength "tests", ("test" as defined in paragraph Strength Requirements in

PART 1) moving average of last 3 "tests" for strength, and moving average for range for the last 3 "tests" for each mixture. The charts shall be similar to those found in ACI 214.3R.

#### 3.14.6 Inspection Before Placing

Foundations, construction joints, forms, and embedded items shall be inspected by the Contractor in sufficient time prior to each concrete placement in order to certify to the Contracting Officer that they are ready to receive concrete. The results of each inspection shall be reported in writing.

#### 3.14.7 Placing

The placing foreman shall supervise placing operations, shall determine that the correct quality of concrete or grout is placed in each location as specified and as directed by the Contracting Officer, and shall be responsible for measuring and recording concrete temperatures and ambient temperature hourly during placing operations, weather conditions, time of placement, volume placed, and method of placement. The placing foreman shall not permit batching and placing to begin until it has been verified that an adequate number of vibrators in working order and with competent operators are available. Placing shall not be continued if any pile of concrete is inadequately consolidated. If any batch of concrete fails to meet the temperature requirements, immediate steps shall be taken to improve temperature controls.

#### 3.14.8 Vibrators

The frequency and amplitude of each vibrator shall be determined in accordance with COE CRD-C 521 prior to initial use and at least once a month when concrete is being placed. Additional tests shall be made as directed when a vibrator does not appear to be adequately consolidating the concrete. The frequency shall be determined while the vibrator is operating in concrete with the tachometer being held against the upper end of the vibrator head while almost submerged and just before the vibrator is withdrawn from the concrete. The amplitude shall be determined with the head vibrating in air. Two measurements shall be taken, one near the tip and another near the upper end of the vibrator head, and these results averaged. The make, model, type, and size of the vibrator and frequency and amplitude results shall be reported in writing. Any vibrator not meeting the requirements of paragraph Consolidation, shall be immediately removed from service and repaired or replaced.

#### 3.14.9 Curing Inspection

- a. Moist Curing Inspections. At least once each shift, and not less than twice per day on both work and non-work days, an inspection shall be made of all areas subject to moist curing. The surface moisture condition shall be noted and recorded.
- b. Moist Curing Corrective Action. When a daily inspection report lists an area of inadequate curing, immediate corrective action shall be taken, and the required curing period for those areas shall be extended by 1 day.

#### 3.14.10 Cold-Weather Protection

At least once each shift and once per day on non-work days, an inspection

shall be made of all areas subject to cold-weather protection. Any deficiencies shall be noted, corrected, and reported.

#### 3.14.11 Mixer Uniformity

- a. Stationary Mixers. Prior to the start of concrete placing and once every 6 months when concrete is being placed, or once for every 60,000 cubic meters of concrete placed, whichever results in the shortest time interval, uniformity of concrete mixing shall be determined in accordance with ASTM C 94/C 94M.
- b. Truck Mixers. Prior to the start of concrete placing and at least once every 6 months when concrete is being placed, uniformity of concrete mixing shall be determined in accordance with ASTM C 94/C 94M. The truck mixers shall be selected randomly for testing. When satisfactory performance is found in one truck mixer, the performance of mixers of substantially the same design and condition of the blades may be regarded as satisfactory.
- c. Mixer Uniformity Corrective Action. When a mixer fails to meet mixer uniformity requirements, either the mixing time shall be increased, batching sequence changed, batch size reduced, or adjustments shall be made to the mixer until compliance is achieved.

#### 3.14.12 Reports

All results of tests or inspections conducted shall be reported informally as they are completed and in writing daily. A weekly report shall be prepared for the updating of control charts covering the entire period from the start of the construction season through the current week. During periods of cold-weather protection, reports of pertinent temperatures shall be made daily. These requirements do not relieve the Contractor of the obligation to report certain failures immediately as required in preceding paragraphs. Such reports of failures and the action taken shall be confirmed in writing in the routine reports. The Contracting Officer has the right to examine all contractor quality control records.

-- End of Section --



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## SECTION 03410

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## SECTION 03410

PLANT-PRECAST STRUCTURAL CONCRETE  
03/00

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS  
(AASHTO)

AASHTO HB-16 Highway Bridges-Division I-Section 14:  
Bearings

## ACI INTERNATIONAL (ACI)

ACI 304R (1989) Measuring, Mixing, Transporting,  
and Placing Concrete

ACI 305R (1991) Hot Weather Concreting

ACI 306.1 (1990) Cold Weather Concreting

ACI 309R (1996) Consolidation of Concrete

ACI 318/318M (1995) Building Code Requirements for  
Structural Concrete

## AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A135.4 (1995) Basic Hardboard

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 27/A 27M (1995) Steel Castings, Carbon, for General  
Application

ASTM A 36/A 36M (1996) Carbon Structural Steel

ASTM A 47M (1990) Ferritic Malleable Iron Castings  
(Metric)

ASTM A 123/A 123M (1997; Rev. A) Zinc (Hot-Dip Galvanized)  
Coatings on Iron and Steel Products

ASTM A 153/A 153M (1995) Zinc Coating (Hot-Dip) on Iron and  
Steel Hardware

ASTM A 185 (1997) Steel Welded Wire Fabric, Plain,  
for Concrete Reinforcement

ASTM A 307	(1994) Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength
ASTM A 325M	(1993) High-Strength Bolts for Structural Steel Joints (Metric)
ASTM A 497	(1997) Steel Welded Wire Fabric, Deformed, for Concrete Reinforcement
ASTM A 563M	(1996) Carbon and Alloy Steel Nuts (Metric)
ASTM A 615/A 615M	(1996; Rev. A) Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM A 706/A 706M	(1996; Rev. B) Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement
ASTM A 780	(1993; Rev. A) Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
ASTM C 33	(1997) Concrete Aggregates
ASTM C 94	(1997) Ready-Mixed Concrete
ASTM C 150	(1997) Portland Cement
ASTM C 260	(1995) Air-Entraining Admixtures for Concrete
ASTM C 330	(1989) Lightweight Aggregates for Structural Concrete
ASTM C 494	(1992) Chemical Admixtures for Concrete
ASTM C 595M	(1997) Blended Hydraulic Cements (Metric)
ASTM C 618	(1997) Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete
ASTM C 989	(1997) Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars
ASTM C 1107	(1997) Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
ASTM F 436M	(1993) Hardened Steel Washers (Metric)
ASTM F 844	(1990) Washers, Steel, Plain (Flat), Unhardened for General Use

## AMERICAN WELDING SOCIETY (AWS)

AWS D1.4 (1998) Structural Welding Code -  
Reinforcing Steel

## PRECAST/PRESTRESSED CONCRETE INSTITUTE (PCI)

PCI MNL-116 (1985) Quality Control for Plants and  
Production of Precast Prestressed Concrete  
Products

PCI MNL-120 (1992) Design Handbook - Precast and  
Prestressed Concrete

## 1.2 PRECAST MEMBERS

The work includes the provision of precast non-prestressed concrete herein referred to as precast members. Precast members shall be the product of a manufacturer specializing in the production of precast concrete members. In the ACI publications, the advisory provisions shall be considered to be mandatory, as though the word "shall" has been substituted for "should" wherever it appears; reference to the "Building Official," the "Structural Engineer" and the "Architect/Engineer" shall be interpreted to mean the Contracting Officer.

## 1.3 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures."

## SD-02 Shop Drawings

Drawings of precast members; G, AE.

## SD-03 Product Data

Product Data; G, AE.

Anchorage and lifting inserts and devices

Bearing pads

## SD-05 Design Data

Precast concrete members design calculations; G, AE.

Concrete mix design

## SD-06 Test Reports

Contractor-furnished mix design

Submit copies of test reports showing that the mix has been successfully tested to produce concrete with the properties specified and will be suitable for the job conditions. Obtain

approval before concrete placement.

#### SD-07 Certificates

##### Fabrication

Submit quality control procedures established in accordance with PCI MNL-116 by the precast manufacturer.

#### SD-11 Closeout Submittals

Concrete batch ticket information

### 1.4 QUALITY CONTROL

#### 1.4.1 Precast Concrete Member Design

ACI 318/318M and the PCI MNL-120. Provide precast members (including connections) as indicated on the Contract Drawings. Check precast members for handling without cracking in accordance with the PCI MNL-120.

#### 1.4.2 PCI Quality Certifications

PCI MNL-116. At the precast manufacturer's option, in lieu of core samples, ACI 318/318M, full scale load tests may be performed. Perform on randomly selected members, as directed by the Contracting Officer.

##### 1.4.2.1 Product Quality Control

PCI MNL-116 for PCI enrolled plants. Where panels are manufactured by specialists in plants not currently enrolled in the PCI "Quality Control Program," provide a product quality control system in accordance with PCI MNL-116 and perform concrete and aggregate quality control testing using an approved, independent commercial testing laboratory. Submit test results to the Contracting Officer.

or

##### 1.4.2.2 Product Quality Control

Plants shall be certified by the PCI Plant Certification Program for Category C1, C2, C3, or C4 work as required by the Contracting Officer.

### 1.5 DELIVERY AND STORAGE

Lift and support precast members at the lifting and supporting points indicated on the shop drawings. Store precast members off the ground. Separate stacked precast members by battens across the full width of each bearing point. Protect from weather, marring, damage, and overload.

### 1.6 FACTORY INSPECTION

At the option of the Contracting Officer, precast units may be inspected by the Contracting Officer or/and precast units may be inspected by the QC Representative prior to being transported to the job site. The Contractor shall give notice 14 days prior to the time the units will be available for plant inspection. Neither the exercise nor waiver of inspection at the plant will affect the Government's right to enforce contractual provisions after units are transported or erected.

## 1.7 QUALITY ASSURANCE

### 1.7.1 Drawing Information

Submit drawings indicating complete information for the fabrication, handling, and erection of the precast member. Design calculations, as required, and drawings of precast members (including connections) shall be prepared and sealed by a registered professional engineer, and submitted for approval prior to fabrication. The drawings shall indicate, as a minimum, the following information:

- a. Marking of members for erection
- b. Connections for work of other trades
- c. Location and size of openings
- d. Headers for openings
- e. Any joints
- f. Reinforcing details
- g. Material properties of steel and concrete used
- h. Lifting and erection inserts
- i. Dimensions and surface finishes of each member
- j. Erection sequence and handling requirements
- k. All loads used in design (such as handling and erection)
- l. Bracing/shoring required
- m. Areas to receive toppings, topping thickness.

### 1.7.2 Design Calculations

Submit calculations reflecting design conforming to requirements of paragraph entitled "Precast Concrete Member Design." Design calculations and drawings of precast members (including connections) shall be prepared and sealed by a registered professional engineer, and submitted for approval prior to fabrication.

### 1.7.3 Concrete Mix Design

Thirty days minimum prior to concrete placement, submit a mix design for each strength and type of concrete. Include a complete list of materials including type; brand; source and amount of cement, pozzolan, and admixtures; and applicable reference specifications.

### 1.7.4 Certificates: Record Requirement

ASTM C 94. Submit mandatory batch ticket information for each load of ready-mixed concrete.

## PART 2 PRODUCTS

## 2.1 CONTRACTOR-FURNISHED MIX DESIGN

ACI 318/318M. The minimum compressive strength of concrete at 28 days shall be 35 MPa, unless otherwise indicated.

## 2.2 MATERIALS

## 2.2.1 Cement

ASTM C 150, Type I, II, or III; or ASTM C 595M Type IP(MS) or IS(MS) blended cement, except as modified herein. The blended cement shall consist of a mixture of ASTM C 150 cement and one of the following materials: ASTM C 618 pozzolan or fly ash, or ASTM C 989 ground iron blast furnace slag. The pozzolan/fly ash content shall not exceed 25 percent by weight of the total cementitious material. For exposed concrete, use one manufacturer for each type of cement, ground slag, fly ash, and pozzolan.

## 2.2.1.1 Fly Ash and Pozzolan

ASTM C 618, Type N, F, or C, except that the maximum allowable loss on ignition shall be 6 percent for Type N and F.

## 2.2.1.2 Ground Iron Blast-Furnace Slag

ASTM C 989, Grade 100 or 120.

## 2.2.2 Water

Water shall be fresh, clean, and potable.

## 2.2.3 Aggregates

## 2.2.3.1 Aggregates Selection

ASTM C 33, Size 57, except as modified herein. Obtain aggregates for exposed concrete surfaces from one source. Aggregates shall not contain any substance which may be deleteriously reactive with the alkalies in the cement.

## 2.2.3.2 Aggregates for Lightweight Concrete

ASTM C 330.

## 2.2.4 Grout

## 2.2.4.1 Nonshrink Grout

ASTM C 1107.

## 2.2.4.2 Cementitious Grout

Shall be a mixture of portland cement, sand, and water. Proportion one part cement to approximately 2.5 parts sand, with the amount of water based on placement method. Provide air entrainment for grout exposed to the weather.

## 2.2.5 Admixtures



## 2.2.5.1 Air-Entraining

ASTM C 260.

## 2.2.5.2 Accelerating

ASTM C 494, Type C or E.

## 2.2.5.3 Water Reducing

ASTM C 494, Type A, E, or F.

## 2.2.6 Reinforcement

## 2.2.6.1 Reinforcing Bars

ASTM A 706/A 706M, Grade 400; ASTM A 615/A 615M, Grade 400; and ASTM A 615/A 615M, Grade 300 as indicated on the Contract Drawings.

## 2.2.6.2 Welded Wire Fabric

ASTM A 185 or ASTM A 497.

## 2.2.7 Metal Accessories

Provide ASTM A 123/A 123M or ASTM A 153/A 153M galvanized.

## 2.2.7.1 Inserts

ASTM A 47M, Grade 22010, or ASTM A 27/A 27M Grade 415-205.

## 2.2.7.2 Structural Steel

ASTM A 36/A 36M.

## 2.2.7.3 Bolts

ASTM A 307; ASTM A 325M.

## 2.2.7.4 Nuts

ASTM A 563M.

## 2.2.7.5 Washers

ASTM F 844 washers for ASTM A 307 bolts, and ASTM F 436M washers for ASTM A 325M bolts.

## 2.2.8 Bearing Pads

## 2.2.8.1 Elastomeric

AASHTO HB-16, for plain neoprene bearings.

## 2.2.8.2 Hardboard (Interior Only)

ANSI A135.4, class as specified by the precast manufacturer.

## 2.3 FABRICATION

PCI MNL-116 unless specified otherwise.

### 2.3.1 Forms

Brace forms to prevent deformation. Forms shall produce a smooth, dense surface. Chamfer exposed edges of columns and beams 200 mm, unless otherwise indicated. Provide threaded or snap-off type form ties.

### 2.3.2 Reinforcement Placement

ACI 318/318M for placement and splicing. Reinforcement may be preassembled before placement in forms. Provide exposed connecting bars, or other approved connection methods, between precast and cast-in-place construction. Remove any excess mortar that adheres to the exposed connections.

### 2.3.3 Concrete

#### 2.3.3.1 Concrete Mixing

ASTM C 94. Mixing operations shall produce batch-to-batch uniformity of strength, consistency, and appearance.

#### 2.3.3.2 Concrete Placing

ACI 304R, ACI 305R for hot weather concreting, ACI 306.1 for cold weather concreting, and ACI 309R, unless otherwise specified.

#### 2.3.3.3 Concrete Curing

Commence curing immediately following the initial set and completion of surface finishing. Provide curing procedures to keep the temperature of the concrete between 10 and 90 degrees C. When accelerated curing is used, apply heat at controlled rate and uniformly along the casting beds. Monitor temperatures at various points in a product line in different casts.

### 2.3.4 Surface Finish

Repairs located in a bearing area shall be approved by the Contracting Officer prior to repairs. Precast members containing hairline cracks which are visible and are less than 0.5 mm in width, may be accepted, except that cracks larger than 0.1 mm in width for surfaces exposed to the weather shall be repaired. Precast members which contain cracks greater than 0.5 mm in width shall be approved by the Contracting Officer, prior to being repaired. Any precast member that is structurally impaired or contains honeycombed section deep enough to expose reinforcing shall be rejected.

#### 2.3.4.1 Unformed Surfaces

Roughen top of joists.

#### 2.3.4.2 Formed Surfaces

PCI MNL-116 (Appendix A - Commentary), Chapter 3, for grades of surface finishes.

- a. Unexposed Surfaces: Provide a standard grade surface finish.

- b. Exposed Surfaces: Provide a standard grade surface finish. The combined area of acceptable defective areas shall not exceed 0.2 percent of the exposed to view surface area, and the patches shall be indistinguishable from the surrounding surfaces when dry.

## PART 3 EXECUTION

### 3.1 SURFACE REPAIR

Prior to erection, and again after installation, precast members shall be checked for damage, such as cracking, spalling, and honeycombing. As directed by the Contracting Officer, precast members that do not meet the surface finish requirements specified in Part 2 in paragraph entitled "Surface Finish" shall be repaired, or removed and replaced with new precast members.

### 3.2 ERECTION

Precast members shall be erected after the concrete has attained the specified compressive strength, unless otherwise approved by the precast manufacturer. Erect in accordance with the approved shop drawings. PCI MNL-116 and PCI MNL-120 (Chapter 8), for tolerances. Brace precast members, unless design calculations submitted with the shop drawings indicate bracing is not required. Follow the manufacturer's recommendations for maximum construction loads. Place precast members level, plumb, square, and true within tolerances. Align member ends.

### 3.3 BEARING SURFACES

Shall be flat, free of irregularities, and properly sized. Size bearing surfaces to provide for the indicated clearances between the precast member and adjacent precast members or adjoining field placed surfaces. Correct bearing surface irregularities with nonshrink grout. Provide bearing pads where indicated or required. Do not use hardboard bearing pads in exterior locations. Place precast members at right angles to the bearing surface, unless indicated otherwise, and draw-up tight without forcing or distortion, with sides plumb.

### 3.4 ANCHORAGE

Provide anchorage for fastening work in place. Conceal fasteners where practicable. Make threaded connections up tight and nick threads to prevent loosening.

### 3.5 WELDING

AWS D1.4 for welding connections and reinforcing splices. Protect the concrete and other reinforcing from heat during welding. Weld continuously along the entire area of contact. Grind smooth visible welds in the finished installation. Welding of epoxy-coated reinforcing is not allowed.

### 3.6 OPENINGS

Holes or cuts requiring reinforcing to be cut, which are not indicated on the approved shop drawing, shall only be made with the approval of the Contracting Officer and the precast manufacturer. Drill holes less than 300 mm in diameter with a diamond tipped core drill.

### 3.7 GALVANIZING REPAIR

Repair damage to galvanized coatings using ASTM A 780 zinc rich paint for galvanized surfaces damaged by handling, transporting, cutting, welding, bolting, or acid washing. Do not heat surfaces to which repair paint has been applied.

### 3.8 GROUTING

Clean and fill keyways between precast members, and other indicated areas, solidly with nonshrink grout or cementitious grout. Provide reinforcing where indicated. Remove excess grout before hardening.

### 3.9 SEALANTS

Provide as indicated and as specified in Section 07920N, "Joint Sealants."

-- End of Section --

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## DIVISION 04 - MASONRY

## SECTION 04200

## MASONRY

**08/02**

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## SECTION 04200

MASONRY  
08/02

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by basic designation only.

## ACI INTERNATIONAL (ACI)

ACI 530.1 (1999) Specifications for Masonry Structures and Related Commentaries

ACI SP-66 (1994) ACI Detailing Manual

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 82 (2001) Steel Wire, Plain, for Concrete Reinforcement

ASTM A 153/A 153M (2001a) Zinc Coating (Hot-Dip) on Iron and Steel Hardware

ASTM A 615/A 615M (2001b) Deformed and Plain Billet-Steel Bars for Concrete Reinforcement

ASTM C 90 (2002) Loadbearing Concrete Masonry Units

ASTM C 94/C 94M (2000e2) Ready-Mixed Concrete

ASTM C 144 (1999) Aggregate for Masonry Mortar

ASTM C 150 (2002) Portland Cement

ASTM C 207 (1991; R 1997) Hydrated Lime for Masonry Purposes

ASTM C 270 (2001a) Mortar for Unit Masonry

ASTM C 476 (2001) Grout for Masonry

ASTM C 641 (1998e1) Staining Materials in Lightweight Concrete Aggregates

ASTM C 780 (2000) Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry

ASTM C 1019 (2000b) Sampling and Testing Grout

ASTM C 1142 (1995; R 2001) Extended Life Mortar for

## Unit Masonry

ASTM E 447

(1997) Compressive Strength of Masonry  
Prisms

## 1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

## SD-02 Shop Drawings

Masonry Work; G, AE.

Drawings including plans, elevations, and details of wall reinforcement; details of reinforcing bars at corners and wall intersections; offsets; tops, bottoms, and ends of walls; lintels; and wall openings. Bar splice locations shall be shown. If the Contractor opts to furnish inch-pound CMU products, drawings showing elevation of walls exposed to view and indicating the location of all cut CMU products shall be submitted for approval. Bent bars shall be identified on a bending diagram and shall be referenced and located on the drawings. Wall dimensions, bar clearances, and wall openings greater than one masonry unit in area shall be shown. Location of these additional openings shall be clearly highlighted. The minimum scale for wall elevations shall be 1 to 50. Reinforcement bending details shall conform to the requirements of ACI SP-66.

## SD-03 Product Data

Insulation; G, AE.

Manufacturer's descriptive data.

Cold Weather Installation; G, AE.

Cold weather construction procedures.

## SD-05 Design Data

Pre-mixed Mortar; G, AE.

Unit Strength Method; G, AE.

Pre-mixed mortar composition. Calculations and certifications of masonry unit and mortar strength.

## SD-08 Manufacturer's Instructions

Masonry Cement; G, AE.

When masonry cement is used, submit the manufacturer's printed instructions on proportions of water and aggregates and on mixing to obtain the type of mortar required.



### 1.3 DELIVERY, HANDLING, AND STORAGE

Materials shall be delivered, handled, stored, and protected to avoid chipping, breakage, and contact with soil or contaminating material.

#### 1.3.1 Masonry Units

Concrete masonry units shall be covered or protected from inclement weather. Store Type II, concrete masonry units at the site for a minimum of 28 days for air cured units, 10 days for atmospheric steam or water cured units, and 3 days for units cured with steam at a pressure of 800 to 1000 kPa and at a temperature of 180 to 185 degrees C for at least 5 hours.

Protect moisture controlled units (Type I) from rain and ground water. Prefabricated lintels shall be marked on top sides to show either the lintel schedule number or the number and size of top and bottom bars.

#### 1.3.2 Reinforcement, Anchors, and Ties

Steel reinforcing bars, coated anchors, ties, and joint reinforcement shall be stored above the ground. Steel reinforcing bars and uncoated ties shall be free of loose mill scale and rust.

#### 1.3.3 Cementitious Materials, Sand and Aggregates

Cementitious and other packaged materials shall be delivered in unopened containers, plainly marked and labeled with manufacturers' names and brands. Cementitious material shall be stored in dry, weathertight enclosures or be completely covered. Cement shall be handled in a manner that will prevent the inclusion of foreign materials and damage by water or dampness. Sand and aggregates shall be stored in a manner to prevent contamination or segregation.

### 1.4 QUALITY ASSURANCE

#### 1.4.1 Testing

Masonry strength shall be determined in accordance with ACI 530.1; submit test reports on three prisms in accordance with ASTM E 447, Method B modified as specified in ACI 530.1. The cost of testing shall be paid by the Contractor.

#### 1.4.2 Spare Vibrator

Maintain at least one spare vibrator on site at all times.

#### 1.4.3 Bracing and Scaffolding

Provide bracing and scaffolding necessary for masonry work. Design bracing to resist wind pressure as required by local code.

## PART 2 PRODUCTS

### 2.1 GENERAL REQUIREMENTS

The source of materials which will affect the appearance of the finished work shall not be changed after the work has started except with Contracting Officer's approval. The Contractor has the option to use either hard metric or substitute inch-pound (soft-metric) CMU products.

- a. Maintain wall centerline locations to accommodate inch-pound CMU products.
- b. Mortar joint widths shall be maintained as specified.
- c. Rebars shall not be cut, bent or eliminated to fit into the inch-pound CMU products module.
- d. Inch-pound CMU products shall not be reduced in size by more than one-third (1/3) in height and one-half (1/2) in length. Cut CMU products shall not be located at ends of walls, corners, and other openings.
- e. Cut, exposed products shall be held to a minimum and located where they would have the least impact on the architectural aesthetic goals of the facility.
- f. Coordinate size of openings for other building components, built into the CMU products, such as window frames, door frames, louvers, grilles.
- g. Additional metric guidance shall conform to Section 01415 METRIC MEASUREMENTS.

## 2.2 CONCRETE MASONRY UNITS (CMU)

Cement shall have a low alkali content and be of one brand. Units shall be of modular dimensions and air, water, or steam cured. Exposed surfaces of units shall be smooth and of uniform texture.

- a. Hollow Non-Load-Bearing Units: ASTM C 129, Type I or II, made with lightweight normal weight aggregate. Load-bearing units may be provided in lieu of non-load-bearing units.
- b. Solid Non-Load-Bearing Units: ASTM C 90, Type I or II, normal weight units. Provide solid units as indicated.

### 2.2.1 Aggregates

Lightweight aggregates and blends of lightweight and heavier aggregates in proportions used in producing the units, shall comply with the following requirements when tested for stain-producing iron compounds in accordance with ASTM C 641: by visual classification method, the iron stain deposited on the filter paper shall not exceed the "light stain" classification.

### 2.2.2 Kinds and Shapes

Units shall be modular in size and shall include soaps, corner units, closer, jamb, header, lintel, and bond beam units and special shapes and sizes to complete the work as indicated. In exposed interior masonry surfaces, units having a bullnose shall be used for vertical external corners except at door, window, and louver jambs. Radius of the bullnose shall be 25 mm. Units used in exposed masonry surfaces in any one building shall have a uniform fine to medium texture.

## 2.3 PRECAST CONCRETE ITEMS

Splashblocks shall be factory-made units from a plant regularly engaged in producing precast concrete units. Unless otherwise indicated, concrete

shall be 20 MPa minimum conforming to Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE using 13 mm (1/2 inch) to No. 4 nominal-size coarse aggregate, and minimum reinforcement shall be the reinforcement required for handling of the units. Clearance of 20 mm shall be maintained between reinforcement and faces of units. Unless precast-concrete items have been subjected during manufacture to saturated-steam pressure of at least 827 kPa (120 psi) for at least 5 hours, the items, after casting, shall be either damp-cured for 24 hours or steam-cured and shall then be aged under cover for 28 days or longer. Exposed-to-view surfaces shall be free of surface voids, spalls, cracks, and chipped or broken edges. Precast units exposed-to-view shall be of uniform appearance and color. Unless otherwise specified, units shall have a smooth dense finish.

#### 2.3.1 Splash Blocks

Splash blocks shall be as detailed. Reinforcement shall be the manufacturer's standard.

#### 2.4 MASONRY MORTAR

Mortar Type S shall conform to the proportion specification of ASTM C 270 except Type S cement-lime mortar proportions shall be 1 part cement, 1/2 part lime and 4-1/2 parts aggregate; Type N cement-lime mortar proportions shall be 1 part cement, 1 part lime and 6 parts aggregate. Type S mortar shall be used for non-load-bearing, non-shear-wall interior masonry; and Type S for remaining masonry work; except where higher compressive strength is indicated on structural drawings. When masonry cement ASTM C 91 is used the maximum air content shall be limited to 12 percent and performance equal to cement-lime mortar shall be verified. Verification of masonry cement performance shall be based on ASTM C 780 and ASTM C 1072. Cement shall have a low alkali content and be of one brand. Aggregates shall be from one source.

##### 2.4.1 Admixtures for Masonry Mortar

Cold weather, accelerating admixtures are prohibited.

##### 2.4.2 Colored Mortar

Mortar color shall be natural gray.

##### 2.4.3 Hydrated Lime and Alternates

Hydrated lime shall conform to ASTM C 207, Type S. Lime alternates which have a current ICBO, ICBO UBC, Evaluation Report number whose findings state it may be used as an alternate to lime for Type M, S, N, and O mortars will be deemed acceptable provided the user follows the manufacturer's proportions and mixing instructions as set forth in ICBO report.

##### 2.4.4 Cement

Portland cement shall conform to ASTM C 150, Type I, IA, II, IIA, III or IIIA. Masonry cement shall conform to ASTM C 91, Type N. Containers shall bear complete instructions for proportioning and mixing to obtain the required types of mortar.

##### 2.4.5 Pre-Mixed Mortar

Pre-mixed mortar shall conform to ASTM C 1142, Type RN.

#### 2.4.6 Sand and Water

Sand shall conform to ASTM C 144. Water shall be clean, potable, and free from substances which could adversely affect the mortar.

### 2.5 GROUT AND READY-MIXED GROUT

Grout shall conform to ASTM C 476,. Cement used in grout shall have a low alkali content. Grout slump shall be between 200 and 250 mm. Minimum grout strength shall be 14 MPa in 28 days, as tested by ASTM C 1019. Grout shall be used subject to the limitations of Table III. Proportions shall not be changed and materials with different physical or chemical characteristics shall not be used in grout for the work unless additional evidence is furnished that the grout meets the specified requirements. Ready-Mixed grout shall conform to ASTM C 94/C 94M.

#### 2.5.1 Admixtures for Grout

Cold weather, accelerating admixtures are prohibited.

#### 2.5.2 Grout Barriers

Grout barriers for vertical cores shall consist of fine mesh wire, fiberglass, or expanded metal.

### 2.6 ANCHORS, TIES, AND BAR POSITIONERS

Anchors and ties shall be fabricated without drips or crimps and shall be zinc-coated in accordance with ASTM A 153/A 153M, Class B-2. Steel wire used for anchors and ties shall be fabricated from steel wire conforming to ASTM A 82. Anchors and ties shall be sized to provide a minimum of 16 mm mortar cover from either face.

#### 2.6.1 Bar Positioners

Bar positioners, used to prevent displacement of reinforcing bars during the course of construction, shall be factory fabricated from 9 gauge steel wire or equivalent, and coated with a hot-dip galvanized finish. Not more than one wire shall cross the cell.

### 2.7 JOINT REINFORCEMENT

Joint reinforcement shall be factory fabricated from steel wire conforming to ASTM A 82, welded construction. Tack welding will not be acceptable in reinforcement used for wall ties. Wire shall have zinc coating conforming to ASTM A 153/A 153M, Class B-2. All wires shall be a minimum of 9 gauge. Reinforcement shall be ladder type design, having one longitudinal wire in the mortar bed of each face shell for hollow units and one wire for solid units. Joint reinforcement shall be placed a minimum of 16 mm cover from either face. The distance between crosswires shall not exceed 400 mm. Joint reinforcement for straight runs shall be furnished in flat sections not less than 3 m long. Joint reinforcement shall be provided with factory formed corners and intersections.

### 2.8 REINFORCING STEEL BARS AND RODS

Reinforcing steel bars and rods shall conform to ASTM A 615/A 615M, Grade

60 or ASTM A 616/A 616M.

### PART 3 EXECUTION

#### 3.1 PREPARATION

Prior to start of work, masonry inspector shall verify the applicable conditions as set forth in ACI 530.1, inspection. The Contracting Officer will serve as inspector or will select a masonry inspector.

##### 3.1.1 Hot Weather Installation

The following precautions shall be taken if masonry is erected when the ambient air temperature is more than 37 degrees C in the shade and the relative humidity is less than 50 percent or the ambient air temperature exceeds 32 degrees C and the wind velocity is more than 13 km/h. All masonry materials shall be shaded from direct sunlight; mortar beds shall be spread no more than 1.2 m ahead of masonry; masonry units shall be set within one minute of spreading mortar; and after erection, masonry shall be protected from direct exposure to wind and sun for 48 hours.

##### 3.1.2 Cold Weather Installation

Before erecting masonry when ambient temperature or mean daily air temperature falls below 4 degrees C or temperature of masonry units is below 4 degrees C, a written statement of proposed cold weather construction procedures shall be submitted for approval. The following precautions shall be taken during all cold weather erection.

###### 3.1.2.1 Protection

Ice or snow formed on the masonry bed shall be thawed by the application of heat. Heat shall be applied carefully until the top surface of the masonry is dry to the touch. Sections of masonry deemed frozen and damaged shall be removed before continuing construction of those sections.

- a. Air Temperature 4 to 0 degrees C. Sand or mixing water shall be heated to produce mortar temperatures between 4 and 49 degrees C.
- b. Air Temperature 0 to minus 4 degrees C. Sand and mixing water shall be heated to produce mortar temperatures between 4 and 49 degrees C. Temperature of mortar on boards shall be maintained above freezing.
- c. Air Temperature minus 4 to minus 7 degrees C. Sand and mixing water shall be heated to provide mortar temperatures between 4 and 49 degrees C. Temperature of mortar on boards shall be maintained above freezing. Sources of heat shall be used on both sides of walls under construction. Windbreaks shall be employed when wind is in excess of 24 km/hour.
- d. Air Temperature minus 7 degrees C and below. Sand and mixing water shall be heated to provide mortar temperatures between 4 and 49 degrees C. Enclosure and auxiliary heat shall be provided to maintain air temperature above 0 degrees C. Temperature of units when laid shall not be less than minus 7 degrees C.

###### 3.1.2.2 Completed Masonry and Masonry Not Being Worked On

- a. Mean daily air temperature 4 to 0 degrees C. Masonry shall be protected from rain or snow for 24 hours by covering with weather-resistive membrane.
- b. Mean daily air temperature 0 to minus 4 degrees C. Masonry shall be completely covered with weather-resistant membrane for 24 hours.
- c. Mean Daily Air Temperature minus 4 to minus 7 degrees C. Masonry shall be completely covered with insulating blankets or equally protected for 24 hours.
- d. Mean Daily Temperature minus 7 degrees C and Below. Masonry temperature shall be maintained above 0 degrees C for 24 hours by enclosure and supplementary heat, by electric heating blankets, infrared heat lamps, or other approved methods.

### 3.1.3 Stains

Protect exposed surfaces from mortar and other stains. When mortar joints are tooled, remove mortar from exposed surfaces with fiber brushes and wooden paddles. Protect base of walls from splash stains by covering adjacent ground with sand, sawdust, or polyethylene.

### 3.1.4 Loads

Do not apply uniform loads for at least 12 hours or concentrated loads for at least 72 hours after masonry is constructed. Provide temporary bracing as required.

### 3.1.5 Surfaces

Surfaces on which masonry is to be placed shall be cleaned of laitance, dust, dirt, oil, organic matter, or other foreign materials and shall be slightly roughened to provide a surface texture with a depth of at least 3 mm. Sandblasting shall be used, if necessary, to remove laitance from pores and to expose the aggregate.

## 3.2 LAYING MASONRY UNITS

Coordinate masonry work with the work of other trades to accommodate built-in items and to avoid cutting and patching. Masonry units shall be laid in running bond pattern. Each unit shall be adjusted to its final position while mortar is still soft and plastic. Units that have been disturbed after the mortar has stiffened shall be removed, cleaned, and relaid with fresh mortar. Air spaces, cavities, chases, expansion joints, and spaces to be grouted shall be kept free from mortar and other debris. Units used in exposed masonry surfaces shall be selected from those having the least amount of chipped edges or other imperfections detracting from the appearance of the finished work. Vertical joints shall be kept plumb. Units being laid and surfaces to receive units shall be free of water film and frost. Solid units shall be laid in a nonfurrowed full bed of mortar. Units shall be shoved into place so that the vertical joints are tight. Vertical joints of concrete masonry units, except where indicated at control, expansion, and isolation joints, shall be completely filled with mortar. Mortar will be permitted to protrude up to 13 mm into the space or cells to be grouted. Means shall be provided to prevent mortar from dropping into the space below.

### 3.2.1 Forms and Shores

Provide bracing and scaffolding as required. Design bracing to resist wind pressure as required by local codes. Forms and shores shall be sufficiently rigid to prevent deflections which may result in cracking or other damage to supported masonry and sufficiently tight to prevent leakage of mortar and grout. Supporting forms and shores shall not be removed in less than 10 days.

### 3.2.2 Reinforced Concrete Masonry Units Walls

Where vertical reinforcement occurs, fill cores solid with grout. Lay units in such a manner as to preserve the unobstructed vertical continuity of cores to be filled. Embed the adjacent webs in mortar to prevent leakage of grout. Remove mortar fins protruding from joints before placing grout. Minimum clear dimensions of vertical cores shall be 50 by 75 mm. Position reinforcing accurately as indicated before placing grout. As masonry work progresses, secure vertical reinforcing in place at vertical intervals not to exceed 160 bar diameters. Use puddling rod or vibrator to consolidate the grout. Minimum clear distance between masonry and vertical reinforcement shall be not less than 12 mm. Unless indicated or specified otherwise, form splices by lapping bars not less than 40 bar diameters and wire tying them together.

### 3.2.3 Concrete Masonry Units

Units shall be full bedded under both face shells. Head joints shall be filled solidly with mortar for a distance in from the face of the unit not less than the thickness of the face shell. Jamb units shall be of the shapes and sizes to conform with wall units. Solid units may be incorporated in the masonry work where necessary to fill out at corners, and elsewhere as approved.

### 3.2.4 Tolerances

Masonry shall be laid plumb, true to line, with courses level. Bond pattern shall be kept plumb throughout. Corners shall be square unless noted otherwise. Masonry shall be laid within the following tolerances (plus or minus unless otherwise noted):

TABLE II

#### TOLERANCES

Variation from the plumb in the lines and surfaces of walls

---

In adjacent masonry units	3 mm
In 3 m	6 mm
In 6 m	10 mm
In 12 m or more	13 mm

Variations from the plumb for external corners, expansion joints, and other conspicuous lines

---

In 6 m	6 mm
In 12 m or more	13 mm

## TOLERANCES

Variations from the level for exposed lintels,  
and other  
conspicuous lines

---

In 6 m	6 mm
In 12 m or more	13 mm

Variation from level for bed joints and top  
surfaces of bearing walls

---

In 3 m	6 mm
In 12 m or more	13 mm

Variations from horizontal lines

---

## 3.2.5 Cutting and Fitting

Full units of the proper size shall be used wherever possible, in lieu of cut units. Cutting and fitting, including that required to accommodate the work of others, shall be done by masonry mechanics using power masonry saws. Concrete masonry units may be wet or dry cut. Wet cut units, before being placed in the work, shall be dried to the same surface-dry appearance as uncut units being laid in the wall. Cut edges shall be clean, true and sharp. Openings in the masonry shall be made carefully so that wall plates, cover plates or escutcheons required by the installation will completely conceal the openings and will have bottoms parallel with the masonry bed joints. Reinforced masonry lintels shall be provided above openings over 300 mm wide for pipes, ducts, cable trays, and other wall penetrations, unless steel sleeves are used.

## 3.2.6 Jointing

Joints shall be tooled when the mortar is thumbprint hard. Horizontal joints shall be tooled last. Joints shall be brushed to remove all loose and excess mortar. Mortar joints shall be finished as follows:

## 3.2.6.1 Flush Joints

Joints in concealed masonry surfaces and joints at electrical outlet boxes in wet areas shall be flush cut. Flush cut joints shall be made by cutting off the mortar flush with the face of the wall.

## 3.2.6.2 Tooled Joints

Joints in exposed masonry surfaces shall be tooled slightly concave. Joints shall be tooled with a jointer slightly larger than the joint width so that complete contact is made along the edges of the unit. Tooling shall be performed so that the mortar is compressed and the joint surface is sealed. Jointer of sufficient length shall be used to obtain a straight and true mortar joint.

## 3.2.7 Joint Widths



Joint widths shall be as follows:

#### 3.2.7.1 Concrete Masonry Units

Concrete masonry units shall have 10 mm joints.

#### 3.2.8 Embedded Items

Spaces around built-in items shall be filled with mortar. Openings around flush-mount electrical outlet boxes in wet locations shall be pointed with mortar. Anchors, ties, wall plugs, accessories, flashing, pipe sleeves and other items required to be built-in shall be embedded as the masonry work progresses. Anchors, ties and joint reinforcement shall be fully embedded in the mortar.

#### 3.2.9 Unfinished Work

Unfinished work shall be stepped back for joining with new work. Toothing may be resorted to only when specifically approved. Loose mortar shall be removed and the exposed joints shall be thoroughly cleaned before laying new work.

#### 3.2.10 Masonry Wall Intersections

Each course shall be masonry bonded at corners and elsewhere as shown. Masonry walls shall be anchored or tied together at corners and intersections with bond beam reinforcement and prefabricated corner or tee pieces of joint reinforcement as shown.

#### 3.2.11 Partitions

Partitions shall be continuous from floor to underside of floor or roof deck where shown. Openings in firewalls around joists or other structural members shall be filled as indicated or approved. An isolation joint shall be placed in the intersection between partitions and structural or exterior walls as shown. Cells within vertical plane of ties shall be filled solid with grout for full height of partition or solid masonry units may be used.

Interior partitions having masonry walls over 100 mm thick shall be tied together with joint reinforcement. Partitions containing joint reinforcement shall be provided with prefabricated pieces at corners and intersections or partitions.

### 3.3 MORTAR

Mortar shall be mixed in a mechanically operated mortar mixer for at least 3 minutes, but not more than 5 minutes. Measurement of ingredients for mortar shall be by volume. Ingredients not in containers, such as sand, shall be accurately measured by the use of measuring boxes. Water shall be mixed with the dry ingredients in sufficient amount to provide a workable mixture which will adhere to the vertical surfaces of masonry units. Mortar that has stiffened because of loss of water through evaporation shall be retempered by adding water to restore the proper consistency and workability. Mortar that has reached its initial set or that has not been used within 2-1/2 hours after mixing shall be discarded.

### 3.4 REINFORCING STEEL

Reinforcement shall be cleaned of loose, flaky rust, scale, grease, mortar, grout, or other coating which might destroy or reduce its bond prior to

placing grout. Bars with kinks or bends not shown on the drawings shall not be used. Reinforcement shall be placed prior to grouting. Unless otherwise indicated, vertical wall reinforcement shall extend to within 50 mm of tops of walls.

#### 3.4.1 Positioning Bars

Vertical bars shall be accurately placed within the cells at the positions indicated on the drawings. A minimum clearance of 13 mm shall be maintained between the bars and masonry units. Minimum clearance between parallel bars shall be one diameter of the reinforcement. Vertical reinforcing may be held in place using bar positioners located near the ends of each bar and at intermediate intervals of not more than 192 diameters of the reinforcement. Ties shall be in contact with the vertical reinforcement and shall not be placed in horizontal bed joints.

#### 3.4.2 Splices

Bars shall be lapped a minimum of 48 diameters of the reinforcement. Welded or mechanical connections shall develop at least 125 percent of the specified yield strength of the reinforcement.

### 3.5 JOINT REINFORCEMENT INSTALLATION

Joint reinforcement shall be installed at 400 mm on center or as indicated.

Reinforcement shall be lapped not less than 150 mm. Prefabricated sections shall be installed at corners and wall intersections. The longitudinal wires of joint reinforcement shall be placed to provide not less than 16 mm cover to either face of the unit.

### 3.6 PLACING GROUT

Cells containing reinforcing bars shall be filled with grout. Hollow masonry units in walls or partitions supporting plumbing, heating, or other mechanical fixtures, voids at door jambs, and other indicated spaces shall be filled solid with grout. Cells under lintel bearings on each side of openings shall be filled solid with grout for full height of openings. Walls below grade, lintels, and bond beams shall be filled solid with grout. Units other than open end units may require grouting each course to preclude voids in the units. Grout not in place within 1-1/2 hours after water is first added to the batch shall be discarded. Sufficient time shall be allowed between grout lifts to preclude displacement or cracking of face shells of masonry units. If blowouts, flowouts, misalignment, or cracking of face shells should occur during construction, the wall shall be torn down and rebuilt.

#### 3.6.1 Vertical Grout Barriers for Fully Grouted Walls

Grout barriers shall be provided not more than 10 m apart, or as required, to limit the horizontal flow of grout for each pour.

#### 3.6.2 Horizontal Grout Barriers

Grout barriers shall be embedded in mortar below cells of hollow units receiving grout.

#### 3.6.3 Grout Holes and Cleanouts

##### 3.6.3.1 Grout Holes

Openings spaced not more than 400 mm on centers shall be provided where grouting of all hollow unit masonry is indicated. Openings shall not be less than 100 mm in diameter or 75 by 100 mm in horizontal dimensions. Upon completion of grouting operations, grouting holes shall be plugged and finished to match surrounding surfaces.

#### 3.6.3.2 Cleanouts for Hollow Unit Masonry Construction

Cleanout holes shall be provided at the bottom of every pour in cores containing vertical reinforcement when the height of the grout pour exceeds 1.5 m. Where all cells are to be grouted, cleanout courses shall be constructed using bond beam units in an inverted position to permit cleaning of all cells. Cleanout holes shall be provided at a maximum spacing of 800 mm where all cells are to be filled with grout. A new series of cleanouts shall be established if grouting operations are stopped for more than 4 hours. Cleanouts shall not be less than 75 by 100 mm openings cut from one face shell. Manufacturer's standard cutout units may be used at the Contractor's option. Cleanout holes shall not be closed until masonry work, reinforcement, and final cleaning of the grout spaces have been completed and inspected. For walls which will be exposed to view, cleanout holes shall be closed in an approved manner to match surrounding masonry.

#### 3.6.4 Grouting Equipment

##### 3.6.4.1 Grout Pumps

Pumping through aluminum tubes will not be permitted. Pumps shall be operated to produce a continuous stream of grout without air pockets, segregation, or contamination. Upon completion of each day's pumping, waste materials and debris shall be removed from the equipment, and disposed of outside the masonry.

##### 3.6.4.2 Vibrators

Internal vibrators shall maintain a speed of not less than 5,000 impulses per minute when submerged in the grout. At least one spare vibrator shall be maintained at the site at all times. Vibrators shall be applied at uniformly spaced points not further apart than the visible effectiveness of the machine. Duration of vibration shall be limited to time necessary to produce satisfactory consolidation without causing segregation.

#### 3.6.5 Grout Placement

Masonry shall be laid to the top of a pour before placing grout. Grout shall not be placed in hollow unit masonry until mortar joints have set for at least 24 hours. Grout shall be placed using a hand bucket, concrete hopper, or grout pump to completely fill the grout spaces without segregation of the aggregates. Vibrators shall not be inserted into lower pours that are in a semi-solidified state. The height of grout pours and type of grout used shall be limited by the dimensions of grout spaces as indicated in Table III. Low-lift grout methods may be used on pours up to and including 1.5 m in height. High-lift grout methods shall be used on pours exceeding 1.5 m in height.

##### 3.6.5.1 Low-Lift Method

Grout shall be placed at a rate that will not cause displacement of the

masonry due to hydrostatic pressure of the grout. Mortar protruding more than 13 mm into the grout space shall be removed before beginning the grouting operation. Grout pours 300 mm or less in height shall be consolidated by mechanical vibration or by puddling. Grout pours over 300 mm in height shall be consolidated by mechanical vibration and reconsolidated by mechanical vibration after initial water loss and settlement has occurred. Vibrators shall not be inserted into lower pours that are in a semi-solidified state. Low-lift grout shall be used subject to the limitations of Table III.

### 3.6.5.2 High-Lift Method

Mortar droppings shall be cleaned from the bottom of the grout space and from reinforcing steel. Mortar protruding more than 6 mm into the grout space shall be removed by dislodging the projections with a rod or stick as the work progresses. Reinforcing, bolts, and embedded connections shall be rigidly held in position before grouting is started. CMU units shall not be pre-wetted. Grout, from the mixer to the point of deposit in the grout space shall be placed as rapidly as practical by pumping and placing methods which will prevent segregation of the mix and cause a minimum of grout splatter on reinforcing and masonry surfaces not being immediately encased in the grout lift. The individual lifts of grout shall be limited to 1.2 m in height. The first lift of grout shall be placed to a uniform height within the pour section and vibrated thoroughly to fill all voids. This first vibration shall follow immediately behind the pouring of the grout using an approved mechanical vibrator. After a waiting period sufficient to permit the grout to become plastic, but before it has taken any set, the succeeding lift shall be poured and vibrated 300 to 450 mm into the preceding lift. If the placing of the succeeding lift is going to be delayed beyond the period of workability of the preceding, each lift shall be reconsolidated by reworking with a second vibrator as soon as the grout has taken its settlement shrinkage. The waiting, pouring, and reconsolidation steps shall be repeated until the top of the pour is reached. The top lift shall be reconsolidated after the required waiting period. The high-lift grouting of any section of wall between vertical grout barriers shall be completed to the top of a pour in one working day unless a new series of cleanout holes is established and the resulting horizontal construction joint cleaned. High-lift grout shall be used subject to the limitations in Table III.

TABLE III

POUR HEIGHT AND TYPE OF GROUT FOR VARIOUS GROUT SPACE DIMENSIONS

Maximum Grout Pour Height (m) (4)	Grout Type	Grouting Procedure	Minimum Dimensions of the Total Clear Areas Within Grout Spaces and Cells (mm) (1,2)	
			Hollow-unit Masonry	
0.3	Fine	Low Lift	40 x 50	
1.5	Fine	Low Lift	50 x 75	
2.4	Fine	High Lift	50 x 75	
3.6	Fine	High Lift	65 x 75	
7.3	Fine	High Lift	75 x 75	
0.3	Coarse	Low Lift	40 x 75	
1.5	Coarse	Low Lift	65 x 75	

TABLE III

## POUR HEIGHT AND TYPE OF GROUT FOR VARIOUS GROUT SPACE DIMENSIONS

Maximum Grout Pour Height (m) (4)	Grout Type	Grouting Procedure	Minimum Dimensions of the Total Clear Areas Within Grout Spaces and Cells (mm) (1,2)
			Hollow-unit Masonry
2.4	Coarse	High Lift	75 x 75
3.6	Coarse	High Lift	75 x 75
7.3	Coarse	High Lift	75 x 100

## Notes:

- (1) The actual grout space or cell dimension must be larger than the sum of the following items:
  - a) The required minimum dimensions of total clear areas given in the table above;
  - b) The width of any mortar projections within the space;
  - c) The horizontal projections of the diameters of the horizontal reinforcing bars within a cross section of the grout space or cell.
- (2) The minimum dimensions of the total clear areas shall be made up of one or more open areas, with at least one area being 20 mm or greater in width.
- (3) Where only cells of hollow masonry units containing reinforcement are grouted, the maximum height of the pour shall not exceed the distance between horizontal bond beams.

## 3.7 BOND BEAMS

Bond beams shall be filled with grout and reinforced as indicated on the drawings. Grout barriers shall be installed under bond beam units to retain the grout as required. Reinforcement shall be continuous, including around corners, except through control joints or expansion joints, unless otherwise indicated on the drawings. Where splices are required for continuity, reinforcement shall be lapped 48 bar diameters. A minimum clearance of 13 mm shall be maintained between reinforcement and interior faces of units.

## 3.8 LINTELS

## 3.8.1 Masonry Lintels

Masonry lintels shall be constructed with lintel units filled solid with grout in all courses and reinforced with a minimum of two No. 4 bars in the bottom course unless otherwise indicated on the drawings. Lintel reinforcement shall extend beyond each side of masonry opening 40 bar diameters or 600 mm, whichever is greater. Reinforcing bars shall be supported in place prior to grouting and shall be located 13 mm above the bottom inside surface of the lintel unit.

## 3.8.2 Steel Lintels

Steel lintels shall be as shown on the drawings. Lintels shall be set in a

full bed of mortar with faces plumb and true. Steel lintels shall have a minimum bearing length of 200 mm unless otherwise indicated on the drawings.

### 3.9 POINTING AND CLEANING

After mortar joints have attained their initial set, but prior to hardening, mortar and grout daubs or splashings shall be completely removed from masonry-unit surfaces that will be exposed or painted. Before completion of the work, defects in joints of masonry to be exposed or painted shall be raked out as necessary, filled with mortar, and tooled to match existing joints. Immediately after grout work is completed, scum and stains which have percolated through the masonry work shall be removed using a high pressure stream of water and a stiff bristled brush. Masonry surfaces shall not be cleaned, other than removing excess surface mortar, until mortar in joints has hardened. Masonry surfaces shall be left clean, free of mortar daubs, dirt, stain, and discoloration, including scum from cleaning operations, and with tight mortar joints throughout. Metal tools and metal brushes shall not be used for cleaning.

#### 3.9.1 Concrete Masonry Surfaces

Exposed concrete masonry shall be dry-brushed at the end of each day's work and after any required pointing, using stiff-fiber bristled brushes.

### 3.10 PROTECTION

Facing materials shall be protected against staining. Top of walls shall be covered with nonstaining waterproof covering or membrane when work is not in progress. Covering of the top of the unfinished walls shall continue until the wall is waterproofed with a complete roof or parapet system. Covering shall extend a minimum of 600 mm down on each side of the wall and shall be held securely in place. Before starting or resuming, top surface of masonry in place shall be cleaned of loose mortar and foreign material.

### 3.11 TEST REPORTS

#### 3.11.1 Field Testing of Mortar

At least three specimens of mortar shall be taken each day. A layer of mortar 13 to 16 mm thick shall be spread on the masonry units and allowed to stand for one minute. The specimens shall then be prepared and tested for compressive strength in accordance with ASTM C 780.

#### 3.11.2 Field Testing of Grout

Field sampling and testing of grout shall be in accordance with the applicable provisions of ASTM C 1019. A minimum of three specimens of grout per day shall be sampled and tested. Each specimen shall have a minimum ultimate compressive strength of 13.8 MPa at 28 days.

-- End of Section --

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DIVISION 05 - METALS

SECTION 05090

WELDING, STRUCTURAL

**09/98**

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## SECTION 05090

WELDING, STRUCTURAL  
09/98

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC 335 (1989) Specification for Structural Steel Buildings - Allowable Stress Design, Plastic Design

## AMERICAN SOCIETY FOR NONDESTRUCTIVE TESTING (ASNT)

ASNT RP SNT-TC-1A (1996) Recommended Practice SNT-TC-1A

## AMERICAN WELDING SOCIETY (AWS)

AWS A2.4 (1998) Standard Symbols for Welding, Brazing and Nondestructive Examination

AWS A3.0 (1994) Standard Welding Terms and Definitions

AWS D1.1/D1.1M (1998) Structural Welding Code - Steel

AWS Z49.1 (1999) Safety in Welding and Cutting and Allied Processes

## 1.2 DEFINITIONS

Definitions of welding terms shall be in accordance with AWS A3.0.

## 1.3 GENERAL REQUIREMENTS

The design of welded connections shall conform to AISC 335 unless otherwise indicated or specified. Material with welds will not be accepted unless the welding is specified or indicated on the drawings or otherwise approved. Welding shall be as specified in this section, except where additional requirements are shown on the drawings or are specified in other sections. Welding shall not be started until welding procedures, inspectors, nondestructive testing personnel, welders, welding operators, and tackers have been qualified and the submittals furnished to by the Contracting Officer. Qualification testing shall be performed at or near the work site. Each Contractor performing welding shall maintain records of the test results obtained in welding procedure, welder, welding operator, and tacker performance qualifications.



### 1.3.1 Pre-erection Conference

A pre-erection conference shall be held, prior to the start of the field welding, to bring all affected parties together and to gain a naturally clear understanding of the project and the Welding Procedure Specifications (WPS) (which the Contractor shall develop and submit for all welding, including welding done using prequalified procedures). Attendees shall include all Contractor's welding production and inspection personnel and appropriate Government personnel. Items for discussion could include: responsibilities of various parties; welding procedures and processes to be followed; welding sequence (both within a joint and joint sequence within the building); inspection requirements and procedures, both visual and ultrasonic; welding schedule; fabrication of mock-up model; and other items deemed necessary by the attendees.

### 1.3.2 Mock-up Model

The field-welded connection designated as the mock-up model on the drawings shall be the first connection made. All welders qualified and designated to perform field-welded groove joints shall be present during the welding of the mock-up model connections and each one shall perform a part of the welding. The mock-up test shall simulate the physical and environmental conditions that will be encountered during the welding of all groove joints. All inspection procedures required for groove welded joints, including NDE tests, shall be performed on the mock-up model. All Contractor inspection and testing personnel that will perform QC of groove welded joints shall be present during the welding of the mock-up model and each one shall perform the inspection procedures to be performed on production welding of these joints. This mock-up model connection shall be the standard of performance, both for the welding and inspection procedures used and the results to be achieved in the production welding for these groove welded joints.

### 1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

#### SD-03 Product Data

Welding Procedure Qualifications; G, AO.  
Welder, Welding Operator, and Tacker Qualification; G, AO.  
Inspector Qualification; G, AO.  
Previous Qualifications; G, AO.  
Prequalified Procedures; G, AO.

Copies of the welding procedure specifications; the procedure qualification test records; and the welder, welding operator, or tacker qualification test records.

#### SD-06 Test Reports

Quality Control; G, AO.

A quality assurance plan and records of tests and inspections.

## 1.5 WELDING PROCEDURE QUALIFICATIONS

Except for prequalified (per AWS D1.1/D1.1M) and previously qualified procedures, each Contractor performing welding shall record in detail and shall qualify the welding procedure specification for any welding procedure followed in the fabrication of weldments. Qualification of welding procedures shall conform to AWS D1.1/D1.1M and to the specifications in this section. Copies of the welding procedure specification and the results of the procedure qualification test for each type of welding which requires procedure qualification shall be submitted. Approval of any procedure, however, will not relieve the Contractor of the sole responsibility for producing a finished structure meeting all the requirements of these specifications. This information shall be submitted on the forms in Appendix E of AWS D1.1/D1.1M. Welding procedure specifications shall be individually identified and shall be referenced on the detail drawings and erection drawings, or shall be suitably keyed to the contract drawings. In case of conflict between this specification and AWS D1.1/D1.1M, this specification governs.

### 1.5.1 Previous Qualifications

Welding procedures previously qualified by test may be accepted for this contract without requalification if the following conditions are met:

- a. Testing was performed by an approved testing laboratory, technical consultant, or the Contractor's approved quality control organization.
- b. The qualified welding procedure conforms to the requirements of this specification and is applicable to welding conditions encountered under this contract.
- c. The welder, welding operator, and tacker qualification tests conform to the requirements of this specification and are applicable to welding conditions encountered under this contract.

### 1.5.2 Prequalified Procedures

Welding procedures which are considered prequalified as specified in AWS D1.1/D1.1M will be accepted without further qualification. The Contractor shall submit a listing or an annotated drawing to indicate the joints not prequalified. Procedure qualification shall be required for these joints.

### 1.5.3 Retests

If welding procedure fails to meet the requirements of AWS D1.1/D1.1M, the procedure specification shall be revised and requalified, or at the Contractor's option, welding procedure may be retested in accordance with AWS D1.1/D1.1M. If the welding procedure is qualified through retesting, all test results, including those of test welds that failed to meet the requirements, shall be submitted with the welding procedure.

## 1.6 WELDER, WELDING OPERATOR, AND TACKER QUALIFICATION

Each welder, welding operator, and tacker assigned to work on this contract shall be qualified in accordance with the applicable requirements of AWS D1.1/D1.1M and as specified in this section. Welders, welding operators, and tackers who make acceptable procedure qualification test welds will be considered qualified for the welding procedure used.

### 1.6.1 Previous Personnel Qualifications

At the discretion of the Contracting Officer, welders, welding operators, and tackers qualified by test within the previous 6 months may be accepted for this contract without requalification if all the following conditions are met:

- a. Copies of the welding procedure specifications, the procedure qualification test records, and the welder, welding operator, and tacker qualification test records are submitted in accordance with the specified requirements for detail drawings.
- b. Testing was performed by an approved testing laboratory, technical consultant, or the Contractor's approved quality control organization.
- c. The previously qualified welding procedure conforms to the requirements of this specification and is applicable to welding conditions encountered under this contract.
- d. The welder, welding operator, and tacker qualification tests conform to the requirements of this specification and are applicable to welding conditions encountered under this contract.

### 1.6.2 Certificates

Before assigning any welder, welding operator, or tacker to work under this contract, the Contractor shall submit the names of the welders, welding operators, and tackers to be employed, and certification that each individual is qualified as specified. The certification shall state the type of welding and positions for which the welder, welding operator, or tacker is qualified, the code and procedure under which the individual is qualified, the date qualified, and the name of the firm and person certifying the qualification tests. The certification shall be kept on file, and 3 copies shall be furnished. The certification shall be kept current for the duration of the contract.

### 1.6.3 Renewal of Qualification

Requalification of a welder or welding operator shall be required under any of the following conditions:

- a. It has been more than 6 months since the welder or welding operator has used the specific welding process for which he is qualified.
- b. There is specific reason to question the welder or welding operator's ability to make welds that meet the requirements of these specifications.
- c. The welder or welding operator was qualified by an employer other than those firms performing work under this contract, and a qualification test has not been taken within the past 12 months. Records showing periods of employment, name of employer where welder, or welding operator, was last employed, and the process for which qualified shall be submitted as evidence of conformance.
- d. A tacker who passes the qualification test shall be considered eligible to perform tack welding indefinitely in the positions and with the processes for which he is qualified, unless there is some specific reason to question the tacker's ability. In such a case, the tacker shall be

required to pass the prescribed tack welding test.

#### 1.7 INSPECTOR QUALIFICATION

Inspector qualifications shall be in accordance with AWS D1.1/D1.1M. Nondestructive testing personnel shall be qualified in accordance with the requirements of ASNT RP SNT-TC-1A for Levels I or II in the applicable nondestructive testing method. The inspector may be supported by assistant welding inspectors who are not qualified to ASNT RP SNT-TC-1A, and assistant inspectors may perform specific inspection functions under the supervision of the qualified inspector.

#### 1.8 SYMBOLS

Symbols shall be in accordance with AWS A2.4, unless otherwise indicated.

#### 1.9 SAFETY

Safety precautions during welding shall conform to AWS Z49.1.

### PART 2 PRODUCTS

#### 2.1 WELDING EQUIPMENT AND MATERIALS

All welding equipment, electrodes, welding wire, and fluxes shall be capable of producing satisfactory welds when used by a qualified welder or welding operator performing qualified welding procedures. All welding equipment and materials shall comply with the applicable requirements of AWS D1.1/D1.1M.

### PART 3 EXECUTION

#### 3.1 WELDING OPERATIONS

##### 3.1.1 Requirements

Workmanship and techniques for welded construction shall conform to the requirements of AWS D1.1/D1.1M and AISC 335. When AWS D1.1/D1.1M and the AISC ASD 335 specification conflict, the requirements of AWS D1.1 shall govern.

##### 3.1.2 Identification

Welds shall be identified in one of the following ways:

a. Written records shall be submitted to indicate the location of welds made by each welder, welding operator, or tacker.

b. Each welder, welding operator, or tacker shall be assigned a number, letter, or symbol to identify welds made by that individual. The Contracting Officer may require welders, welding operators, and tackers to apply their symbol next to the weld by means of rubber stamp, felt-tipped marker with waterproof ink, or other methods that do not cause an indentation in the metal. For seam welds, the identification mark shall be adjacent to the weld at 1 meter intervals. Identification with die stamps or electric etchers shall not be allowed.

#### 3.2 QUALITY CONTROL

Testing shall be done by an approved inspection or testing laboratory or technical consultant. The Contractor shall perform visual and radiographic, ultrasonic, magnetic particle, or dye penetrant as required by the Contracting Officer inspection to determine conformance with paragraph STANDARDS OF ACCEPTANCE. Procedures and techniques for inspection shall be in accordance with applicable requirements of AWS D1.1/D1.1M, except that in radiographic inspection only film types designated as "fine grain," or "extra fine," shall be employed.

### 3.3 STANDARDS OF ACCEPTANCE

Dimensional tolerances for welded construction, details of welds, and quality of welds shall be in accordance with the applicable requirements of AWS D1.1/D1.1M and the contract drawings. Nondestructive testing shall be by visual inspection methods. The minimum extent of nondestructive testing shall be random 10 percent of each type of welds or joints, as indicated on the drawings. If the failure rate exceeds 10 percent, then the Contracting Officer shall increase the rate of inspection accordingly.

#### 3.3.1 Nondestructive Examination

The welding shall be subject to inspection and tests in the mill, shop, and field. Inspection and tests in the mill or shop will not relieve the Contractor of the responsibility to furnish weldments of satisfactory quality. When materials or workmanship do not conform to the specification requirements, the Government reserves the right to reject material or workmanship or both at any time before final acceptance of the structure containing the weldment.

#### 3.3.2 Destructive Tests

When metallographic specimens are removed from any part of a structure, the Contractor shall make repairs. The Contractor shall employ qualified welders or welding operators, and shall use the proper joints and welding procedures, including peening or heat treatment if required, to develop the full strength of the members and joints cut and to relieve residual stress.

### 3.4 GOVERNMENT INSPECTION AND TESTING

In addition to the inspection and tests performed by the Contractor for quality control, the Government will perform inspection and testing for acceptance to the extent determined by the Contracting Officer. The costs of such inspection and testing will be borne by the Contractor if unsatisfactory welds are discovered, or by the Government if the welds are satisfactory. The work may be performed by the Government's own forces or under a separate contract for inspection and testing. The Government reserves the right to perform supplemental nondestructive and destructive tests to determine compliance with paragraph STANDARDS OF ACCEPTANCE.

### 3.5 CORRECTIONS AND REPAIRS

When inspection or testing indicates defects in the weld joints, the welds shall be repaired using a qualified welder or welding operator as applicable. Corrections shall be in accordance with the requirements of AWS D1.1/D1.1M and the specifications. Defects shall be repaired in accordance with the approved procedures. Defects discovered between passes shall be repaired before additional weld material is deposited. Wherever a defect is removed and repair by welding is not required, the affected area shall be blended into the surrounding surface to eliminate sharp notches,

crevices, or corners. After a defect is thought to have been removed, and before rewelding, the area shall be examined by suitable methods to ensure that the defect has been eliminated. Repair welds shall meet the inspection requirements for the original welds. Any indication of a defect shall be regarded as a defect, unless reevaluation by nondestructive methods or by surface conditioning shows that no unacceptable defect is present.

### 3.6 SPECIAL REQUIREMENTS

Girder to column connections indicating the use of a complete penetration weld require removal of all backing bars. Backing bars in these locations shall be removed by flame cutting followed by grinding of the exposed area.

-- End of Section --

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## DIVISION 05 - METALS

## SECTION 05091

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**09/98**

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## SECTION 05091

ULTRASONIC INSPECTION OF WELDMENTS  
09/98

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN SOCIETY FOR NONDESTRUCTIVE TESTING (ASNT)

ASNT RP SNT-TC-1A	(1996) Recommended Practice SNT-TC-1A
ASNT Q&A Bk C	(1994) Question and Answer Book C: Ultrasonic Testing Method; Levels I, II, III (Supplement to RP SNT-TC-1A)

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM E 165	(1995) Liquid Penetrant Examination
ASTM E 709	(1995) Magnetic Particle Examination

## AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M	(1998) Structural Welding Code - Steel
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## 1.2 DEFINITIONS

## 1.2.1 A Scan

Method of data presentation on a cathode ray tube using rectangular coordinates in which a horizontal base line indicates elapsed time when reading from left to right. A vertical deflection in the base line indicates reflect signal amplitude.

## 1.2.2 Acoustically Similar Material

Material the same as that to be inspected; or another material proven to have acoustical velocity within plus or minus 3 percent and an attenuation within plus or minus 0.009843 dB/mm (0.25 dB/inch) of the inspected material for the inspection frequency and wave mode, using the same mode as that to be used for inspection.

## 1.2.3 Amplitude

When referring to an indication in A scan presentation, amplitude is the vertical height of the indication measured from peak-to-peak for radio frequency indications and trace-to-peak for video indications.

## 1.2.4 Attenuation

Dissipation or loss of energy as ultrasonic vibrations travel through the material. Attenuation is caused almost entirely by scattering of the ultrasonic vibrations generated by the search unit.

#### 1.2.5 Attenuation-Correction Controls

Circuitry to provide a continuous increase in amplification with respect to time. This circuitry compensates for the reduction in sensitivity with depth as a result of sound beam divergence and its attenuation in material.

#### 1.2.6 Back Reflection or End Reflection

Reflection from the opposite side, end, or boundary of the material into which the ultrasonic energy was introduced.

#### 1.2.7 Calibrated Gain Control (Attenuator)

Circuitry with which gain can be reduced finite amounts by switching electrical signal attenuation into the circuit.

#### 1.2.8 Calibration

Process of comparing an instrument or device with a standard to determine accuracy or produce a scale.

#### 1.2.9 Cathode Ray Tube (CRT)

An electron tube in which a controlled beam of electrons from the cathode is used to produce an image on a fluorescent screen at the end of the tube.

#### 1.2.10 Couplant

Any material, usually a liquid or semiliquid, used between the search unit and the inspection surface to exclude air and to convey the ultrasonic vibrations between the search unit and the material being inspected.

#### 1.2.11 Damping Control

Control that varies the duration of transducer ringing.

#### 1.2.12 Decibel (dB)

Units for the logarithmic expression of the ratio of power levels. Power levels can be functions of voltage, current, or impedance, for example. Decibel units having no values of their own are only significant when a reference is stated, as 10 dB above one reference level or 6 dB below another reference level.

#### 1.2.13 Delay Control

Means of delaying the pattern obtained on the CRT.

#### 1.2.14 Discontinuity

Anything within a material that will cause a detectable interruption in an ultrasonic beam.

#### 1.2.15 Distance-Amplitude Correction Curve

Curve showing the relationship between signal amplitude and equal-sized reflecting surfaces at various distances from the transducer. Reference standards are used to obtain such curves.

#### 1.2.16 Dynamic Range

Ratio of maximum to minimum size of reflective areas that can be adequately distinguished on the CRT at a constant gain setting.

#### 1.2.17 Effective Depth of Penetration

Maximum depth at which the sensitivity is satisfactory for the quality of test desired.

#### 1.2.18 Examination

Within the context of this specification, examination is equivalent to the word "inspection."

#### 1.2.19 Gain Control

Circuitry designed into the ultrasonic system to vary reflection amplitude. This control is usually calibrated in decibels. It is also called the sensitivity control.

#### 1.2.20 Gross

Background displacement of the trace on the CRT from the established baseline due to the gain setting, the characteristics of the test equipment, or the material under examination.

#### 1.2.21 Hertz

One complete set of recurrent values of a periodic quantity comprises a cycle. In other words, any one set of periodic variations starting at one condition and returning once to the same condition is a cycle.

#### 1.2.22 Immersion Techniques

Test methods in which the part to be tested and the search units are immersed in water or other suitable liquid couplant. A mechanical device is used to firmly hold and direct the wave angle of the search unit. The search unit does not contact the item being inspected.

#### 1.2.23 Indication

Visual presentation on the cathode ray screen resulting from a sound beam reflection from a boundary surface or discontinuity.

#### 1.2.24 Initial Pulse Indication

Usually called the "initial pulse". A signal on the CRT screen marking the instant at which a voltage impulse is applied to the transmitting crystal. Its rising edge is frequently invisible due to the time lag in the probe shoe and the consequent necessity to ensure coincidence between the time base zero and the instant at which the transmitter pulse actually enters the material under test.

#### 1.2.25 Linearity

Property of an instrument revealed by a linear change in reflected signal or displacement. The vertical linearity is determined by plotting the change in ratios of signal amplitude from two adjacent reflections from an area of known size. The horizontal linearity is determined by plotting the distance the signal is displaced along the sweep against the change in material thickness or by noting the spacing of multiple back reflections.

#### 1.2.26 Longitudinal or Compressional Waves

Simple compression-rarefaction waves in which particle motion within a material is linear and in the direction of wave propagation. Also called straight beams, or compressional or normal waves.

#### 1.2.27 Longitudinal Wave Inspection

Ultrasonic technique, normally using straight beam methods, in which longitudinal waves are the dominant form.

#### 1.2.28 Mid-Screen Reflection

Reflection whose amplitude is equal to one-half the useable screen height on the CRT.

#### 1.2.29 Megahertz (MHz)

One million hertz per second frequency.

#### 1.2.30 NDT Level I

An NDT Level I individual should be qualified to properly perform specific calibrations, specific NDT, and specific evaluations for acceptance or rejection determinations according to written instructions, and to record results.

#### 1.2.31 NDT Level II

An NDT Level II individual should be qualified to set up and calibrate equipment and to interpret and evaluate results with respect to applicable codes, standards, and specifications.

#### 1.2.32 NDT Level III

An NDT Level III individual should be capable of establishing techniques and procedures; interpreting codes, standards, specifications, and procedures; and designating the particular NDT methods, techniques, and procedures to be used.

#### 1.2.33 Node

Distance a shear wave travels in a straight line from the inspection surface before being reflected by the opposite surface.

#### 1.2.34 Pulse Repetition Rate

Number of spaced pulses of sound per second sent into the material being inspected.

#### 1.2.35 Range Control

Means of expanding the pattern obtained on the CRT so that any portion of the total distance being tested can be presented.

#### 1.2.36 Reference Reflector

Standard reflector 1.52 mm (0.06 inch) diameter reference hole in the IIW reference block. Other approved blocks may have a different diameter reflector.

#### 1.2.37 Reflector

Boundary, consisting of an opposite side, crack, or separation, or a distinct change in material such as slag or porosity that reflects the ultrasonic energy the same as a mirror reflects light.

#### 1.2.38 Refracted Waves

Waves that have undergone change of velocity and direction by passing from one material to another material with different acoustical properties. Refraction will occur wherever the angle of the incident wave to the interface is other than perpendicular.

#### 1.2.39 Rejectable Discontinuity (Defect)

Reflector large enough to produce a signal (decibel rating) that exceeds the reject/repair line.

#### 1.2.40 Resolution

Ability to clearly distinguish signals obtained from two reflective surfaces with a minimum separation distance. Near-surface resolution is the ability to clearly distinguish a signal from a reflector at a minimum distance under the contact or near surface without interference from the initial pulse signal. Far-surface resolution is the ability to clearly distinguish signals from reflectors displaced at minimum distances from the far or back surface when the sound beam is normal to that back surface.

#### 1.2.41 Ringing

Excitation in a transducer due to the application of a short pulse of high voltage.

#### 1.2.42 Scanning

Procedure of moving the search unit or units along a test surface to obtain complete inspection of the entire volume of a material being inspected. Preliminary scanning refers to a somewhat common practice of rapidly traversing a weld ultrasonically with a higher instrument gain or sensitivity level than will be used for the evaluation. It gives the operator an estimate of the welding quality and also makes all defects more prominent and less likely to be missed.

#### 1.2.43 Search Unit

Device containing a piezoelectric material used for introducing vibrations into a material to be inspected or for receiving the vibrations reflected from the material. The active element of the search unit is defined as the

effective transmitting area. Search units are also called transducers or probes. They may be single or dual and contain one or two piezoelectric elements, respectively, for transmission and reception. The single search unit is sometimes enclosed in a transducer wheel or search unit wheel. The search unit may be manually handled and placed in direct contact with the material to be inspected or may be held in a fixture for immersion techniques.

#### 1.2.44 Sensitivity

Measure of the ultrasonic equipment's ability to detect discontinuities. Quantitatively, it is the level of amplification of the receiver circuit in the ultrasonic instrument necessary to produce the required indication on the scope from the reference hole in the reference block. Also see "Standard Reference Level."

#### 1.2.45 Shear Waves

Waves in which the particles within the material vibrate perpendicularly to the direction in which the wave travels or propagates. Also called transverse waves.

#### 1.2.46 Shear Wave Inspection

Inspection technique using shear waves in a material. The search unit is placed at an angle to the contact surface of the material so the resultant refracted sound is a shear wave at an angle to the normal.

#### 1.2.47 Standard Reference Level

Mid-screen height reflection when beaming at the 1.52 mm (0.06 inch) hole in the primary reference block or the reference hole in the secondary standard.

#### 1.2.48 Surface Waves

Waves that propagate along the surface of the material and penetrate it to only about 1/2-wavelength. Also known as Rayleigh waves.

#### 1.2.49 Test Frequency

Operating frequency in hertz per second of the search unit during period of activation. Frequency is usually expressed in megacycles per second or megahertz. The latter term has been adopted for international use and is preferred.

#### 1.2.50 Video Form

Type of signal presentation on a CRT in which only the upper half of the signal appears.

### 1.3 GENERAL REQUIREMENTS

A minimum of 15 percent of the full penetration welds shown on the Drawing shall be inspected. If the failure rate exceeds 15 percent, then the contracting officer shall increase the rate of inspection accordingly. The procedures, methods, standards, and description of equipment specified herein shall be used for inspection of weldments. Ultrasonic inspections shall be made to detect the following defects:

- a. Cracks or crack-like faults.
- b. Root defects, including lack of penetration and fusion.
- c. Lack of fusion between passes on the sidewall.
- d. Porosity or inclusions and excessive undercutting.

#### 1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

##### SD-03 Product Data

Ultrasonic Inspection; G, AE.

Procedures and Methods. The pulse echo contact method with an A scan presentation shall be used for the ultrasonic inspection of welded joints, except that immersion techniques may be used for some applications when approved by the Contracting Officer. The Contractor shall provide a standard reference block and working standards as described in paragraph REFERENCE STANDARDS FOR EQUIPMENT, QUALIFICATIONS, AND CALIBRATION. The procedures to be used for personnel and equipment qualification, equipment calibration, and inspection, shall be submitted to the Contracting Officer at least 30 days prior to their intended use. Approval by the Government will in no way affect the obligation of the Contractor to employ qualified personnel, equipment, and procedures, and to perform the inspection as specified. The procedure description shall include the following:

- a. Couplant.
- b. Search unit characteristics including angle, size, shape, nominal frequency, type designation.
- c. Method and type of wave.
- d. Equipment and accessories including manufacturer, model number, date of manufacture, last date of calibration, and the manufacturer's electrical, physical, and performance specifications.
- e. Decibel (dB) compensation system for distance-amplitude correction.

Reports containing the following information:

- a. Identification and Location of Inspected Item: Name and place of the inspected item, the person performing the inspection, and the date of inspection.
- b. Detail of Inspections: Details of methods, types of waves used, search units, frequencies, inspection equipment



identification, and calibration data with enough information to permit duplication of the inspection at a later date.

c. Response in Calibration: The response from the DSC or SC block used in calibration and for acceptance/rejection in terms of the response from the 1.524 mm (0.06 inch) reference hole in the standard IIW block (primary standard).

d. Identification of Unacceptable Areas: Locations, dimensions, types, and area of unacceptable defects and discontinuities giving reflections over 50 percent of the reject/repair line. These may be noted on a sketch or marked-up drawing.

e. Record of Repair Areas: A record of repaired areas shall be furnished as well as test results for the repaired areas.

## 1.5 WAVE TYPES

The types of waves and the conditions under which they shall be used are specified below:

### 1.5.1 Shear Waves

Unless conditions prohibit, shear waves shall be used. A longitudinal wave procedure may be used instead, if approved by the Contracting Officer. Refracted waves between 40 degrees and 70 degrees shall be used except where different angles are indicated in approved procedures, such as for materials less than 13 mm thick, for materials with sound velocities greater than in steel, when the weldments are not readily accessible, or when existing backing rings or backing strips are not removed. For inspection of weldments containing backing rings or backing strips, the instrument shall be adjusted and the refracted angles shall be selected in a way to separate the weldment and the backing ring reflections. The search unit angle and the resulting shear wave angle in the material to be inspected shall be established by the Contractor for each application and this information shall be included in the procedure submitted for approval.

### 1.5.2 Longitudinal Waves

When conditions prohibit the use of shear waves, longitudinal waves may be used. The procedure shall be specially developed to suit the application and shall have the prior approval of the Contracting Officer.

## 1.6 CHANGES IN PROCEDURE

Should application of an approved procedure not provide for good resolution or adequate ultrasonic penetration in the items to be inspected (see paragraph EQUIPMENT QUALIFICATION REQUIREMENTS), changes in procedure or equipment such as frequency, pulse repetition rate, angle of search unit, couplant, or oscilloscope shall be made by the Contractor. Adequacy of the new procedure shall be demonstrated to the Contracting Officer. The Government reserves the right to require a change in test equipment during these tests if any of the following test system characteristics fall below the levels listed in paragraph EQUIPMENT QUALIFICATION REQUIREMENTS: sensitivity, amplitude and distance linearity, signal-to-noise ratio, entry and back surface resolution and penetration.

## 1.7 ULTRASONIC EQUIPMENT

The ultrasonic equipment shall conform to the requirements listed in AWS D1.1/D1.1M Section Inspection, subsection Ultrasonic Equipment, with the following exceptions:

- a. The ultrasonic test instruments shall be able to generate, receive, and to present pulses in the frequency range from 1 to 10 megahertz (MHz).
- b. The horizontal linearity of the ultrasonic instrument shall be measured in accordance with paragraph EQUIPMENT QUALIFICATION REQUIREMENTS.
- c. In addition to the resolution test specified in AWS D1.1/D1.1M, subsection Ultrasonic Equipment, both near- and far-surface resolution tests shall be conducted in accordance with the tests specified for these characteristics in the paragraph EQUIPMENT QUALIFICATION REQUIREMENTS.

## 1.8 PERSONNEL QUALIFICATION AND REQUIREMENTS

### 1.8.1 Personnel Qualification

The three levels of responsibility associated with ultrasonic inspection are defined in ASNT RP SNT-TC-1A. For qualification to perform ultrasonic inspection, personnel shall be certified under ASNT RP SNT-TC-1A and ASNT Q&A Bk C within a period of 1 year before the date of contract. Other qualification or certification may be accepted at the Contracting Officer's discretion. Personnel with only an operator or inspector trainee certification will not be considered qualified to pass judgement on the acceptability of inspected items, but may work under the direct supervision of a qualified ultrasonic inspector. Qualified ultrasonic inspectors shall be able to judge the acceptability of the item in accordance with paragraph ACCEPTANCE/REJECTION LIMITS.

### 1.8.2 Examinations

If the Contracting Officer doubts an individual's ability as an operator, inspector, or supervisor, the individual shall be recertified in accordance with ASNT RP SNT-TC-1A. At the option of the Government, the Contracting Officer may participate in administering the examination and in evaluating the results.

## 1.9 REFERENCE STANDARDS FOR EQUIPMENT, QUALIFICATIONS, AND CALIBRATION

Reference standards shall be used to calibrate the inspection equipment, test its operating condition, and record the sensitivity or response of the equipment during the inspection in accordance with paragraph EQUIPMENT QUALIFICATION REQUIREMENTS. The standards shall comprise a standard reference block and reference specimens as noted below.

### 1.9.1 Standard Reference Block

The standard reference block or primary standard shall be provided by the Contractor and shall consist of the IIW block in AWS D1.1/D1.1M, Section Inspection, subsection Reference Standards. The standard reference block also shall be used in any reinspection on the same basis as the original inspection, even though the reinspection is to be performed by other ultrasonic instruments and accessories.

### 1.9.2 Working Standards

The Contractor may use other recognized working standards detailed with the IIW block in AWS D1.1/D1.1M such as the Sensitivity Calibration (SC) block. However, such blocks shall be referenced to the IIW block as noted in paragraph SENSITIVITY CALIBRATION OF LONGITUDINAL AND ANGLE WAVE SYSTEMS. Details of their use shall be included in the procedure description submitted to the Contracting Officer. These blocks are the secondary standards. They shall be of acoustically similar material to the welds to be inspected. The secondary standards shall be suited for the applicable tests specified in paragraph EQUIPMENT QUALIFICATION REQUIREMENTS and shall be used as follows, except where the IIW block is specifically required:

- a. To assure adequate penetration of the base material.
- b. To provide a secondary field standard.
- c. To calibrate the equipment and establish the standard reference level.

#### 1.9.3 Resolution Test Block

The Contractor shall furnish a resolution test block in accordance with the details shown in AWS D1.1/D1.1M Section Inspection, subsection Ultrasonic Equipment.

#### 1.10 EQUIPMENT QUALIFICATION REQUIREMENTS

The ultrasonic instrument and accessories shall be evaluated on their arrival at the jobsite, immediately prior to the start of inspection. They shall be evaluated using the Contractor's furnished primary standard and shall meet or exceed the requirements listed in paragraphs below. Equipment that does not meet these requirements shall not be used in the inspection.

##### 1.10.1 Requalifications

The equipment shall be requalified after normal use at intervals not to exceed 40 hours, except as noted. The equipment also shall be requalified immediately after maintenance or repair or when the Contracting Officer considers its operation questionable.

##### 1.10.2 Longitudinal Wave System

###### 1.10.2.1 Vertical Amplitude Linearity

Two adjacent reflections of different amplitudes obtained through the thickness of the primary or secondary standard shall vary in the same proportion as the amplitude of the first reflection is increased in discrete 2-dB increments between 20 percent and 80 percent to full screen height. For each gain setting, the amplitude of each reflection shall vary by the same factor, within plus or minus 5 percent. Requalification is required monthly or as otherwise stated.

###### 1.10.2.2 Horizontal Linearity

The first three multiple reflections obtained through the thickness of the primary or secondary standard shall be equally spaced, within plus or minus 5 percent, when spread over 90 percent of the sweep length. Requalification is required monthly or as otherwise stated.

### 1.10.2.3 Near-Surface Resolution

Excessive ringing that appears on the CRT to the right of the sound entry point shall not exceed a 13 mm (1/2 inch) equivalent distance in steel with the search unit placed on the 100 mm (4 inch) edge of the IIW (primary) block and positioned for maximum amplitude reflection from the 1.524 mm (0.06 inch) reference hole of the primary standard. The reference reflector shall be set to mid-screen and the gain shall be increased 20 dB.

The reference hole located at least 13 mm (1/2 inch) from one edge of the AWS DSC or SC secondary standard shall be used similarly. Acceptability will be on the same basis as in the primary standard.

### 1.10.2.4 Far-Surface Resolution

This property of the equipment shall be verified by the method detailed in AWS D1.1/D1.1M, Section Inspection, subsection Calibration of the Ultrasonic Unit with the IIW or Other Approved Calibration Blocks. In addition, the trailing edge of the third reflection shall return to the sweep line and be clearly discernible.

## 1.10.3 Angle Wave System

### 1.10.3.1 Vertical (Amplitude) Linearity

Two adjacent multiple reflections from the 1.524 mm (0.06 inch) reference hole in the primary standard shall vary in the same proportion as the amplitude of the first reflection in discrete 2-dB increments between 20 percent and 80 percent of full screen height. For each gain setting, the amplitude of each adjacent reflection shall vary within plus or minus 5 percent. For testing with the AWS SC or AWS DSC secondary standard, the same criteria shall apply. For the SC block, the transducer shall be placed on the longitudinal surface contiguous with the sound entry point lines, whereas the 100 mm (4 inch) longitudinal surface of the DSC block shall be used for the same purpose. Requalification is required monthly, or as otherwise stated.

### 1.10.3.2 Horizontal Linearity (Angle Wave}

The first three multiple echoes, obtained from the 1.524 mm (0.06 inch) reference hole of the primary standard or from the reference hole in a secondary standard with the transducer positioned at a minimum of 25 mm (1 inch) sound path distance, shall be equally spaced plus or minus 5 percent when spread over 90 percent of the sweep length. The gain shall be adjusted to give a mid-screen height first reflection. Requalification is required monthly or as otherwise stated.

### 1.10.3.3 Near-Surface Resolution (Angle Wave)

The search unit shall be positioned for maximum amplitude using the primary or secondary standard as in the horizontal linearity test. The gain shall be adjusted to give a mid-screen height first reflection and then shall be increased 20 dB. Excessive ringing that appears on the CRT to the right of the sound entry point shall not exceed 13 mm (1/2 inch) equivalent distance in steel.

### 1.10.3.4 Far-Surface Resolution (Angle Wave)

The equipment shall delineate the three resolution holes in the resolution

block appropriate for the angle of the transducer to be used in the inspection.

#### 1.10.3.5 Signal-to-Noise Ratio

With the search unit located as in the horizontal linearity test, the gain shall be set to obtain an 80 percent full screen height first reflection. The reference reflection-to-noise-amplitude ratio shall not be less than 10 to 1.

#### 1.10.3.6 Exit Point

The search unit shall be placed on the graduated scale on the 300 mm (12 inch) edge of the primary standard and the ultrasound shall be beamed toward the curved edge of the block. The gain shall be set for a mid-screen first reflection. The search unit shall be moved back and forth until the first reflection is maximized. The index line on the side of the search unit shall be within 1.6 mm (1/16 inch) of the mid-point of the graduated scale in either direction. Requalification is required after 40 hours or as otherwise stated.

#### 1.10.3.7 Transducer Angle

The established exit point of the probe shall be set over the applicable angle index line scribed on the 200 mm (8 inch) or 300 mm (12 inch) edge, as appropriate, of the primary standard. The gain shall be set to obtain a mid-screen first reflection from the 50 mm plexiglass-lined hole for search units up to 70 percent with the search unit placed on the 200 mm (8 inch) edge. Search units of large angles that have been approved specifically by the Contracting Officer shall be tested from the 300 mm (12 inch) edge using the 1.524 mm (0.06 inch) reference hole. The search unit shall be moved back and forth to maximize the first reflection. When the material to be inspected is not acoustically similar to the primary standard, the inspection angle shall be within plus or minus 2 degrees of the angle specified in the approved procedure. Requalification is required after 40 hours or as otherwise stated.

### 1.11 SENSITIVITY CALIBRATION OF LONGITUDINAL AND ANGLE WAVE SYSTEMS

Sensitivity calibration shall be done immediately after a change of operators and at least every 30 minutes thereafter as testing proceeds. Recalibration will be required after any power interruption, including a change of source, when the equipment is suspected of being in error, or after relocation of the jobsite. The 30-minute and relocation calibrations may coincide. The instrument shall be allowed to warm up before calibration is attempted. The instrument range and delay controls shall be adjusted to display signals from the reference hole in the primary (IIW block) or secondary standard (DSC or SC block or both) on the viewing screen for the range of distances to be inspected.

#### 1.11.1 Calibration Procedure

The test instrument shall be calibrated as described below.

##### 1.11.1.1 Longitudinal Wave

In calibrating with the primary standard, the transducer shall be positioned on the 100 mm (4 inch) edge for maximum reflection from the 1.524 mm (0.06 inch) reference hole. The gain shall be adjusted so that

the first reflection is at 50 percent full scale. The top of that indication shall be marked on the CRT with a wax pencil or by other means. This establishes the standard reference level. A point at 80 percent of the standard reference level shall be calculated and marked. This locates the reject/repair line. If a secondary standard is to be used in the inspection, the reject/repair line shall be established similarly. For the DSC block, the transducer shall be positioned on the 100 mm (4 inch) long surface and with the SC degrees sound entry point lines. Adjustment for loss of signal due to distance shall be compensated for as noted above.

#### 1.11.1.2 Angle Wave

In calibrating with either the primary or secondary standard, the transducer shall be positioned on the same surfaces as in the case of the longitudinal wave system but over the sound entry point lines appropriate for the angle of the transducer to be used in the inspection. The gain shall be adjusted to give a first reflection that is 50 percent of full-scale response. The top of that indication shall be marked with a wax pencil or by other means. This establishes the standard reference level. A point at 80 percent of the standard reference level shall be calculated and marked. This locates the reject/repair line. Loss of signal shall be compensated as noted.

#### 1.11.2 Calibration of the Secondary Standards

After adjusting the first reflection from the reference hole in the secondary standard to 50 percent full-scale response for a sheer or longitudinal wave inspection, a maximized reflection from the 1.524 mm (0.06 inch) reference hole in the primary standard shall be obtained without changing the gain setting. The gain setting shall be readjusted to obtain a 50 percent full-scale reflection and the readjusted setting shall be recorded as required by paragraph SUBMITTALS, SD-18, Records, to provide a basis for recalibration when the secondary standard is unavailable.

#### 1.11.3 Equipment With a Calibrated Gain Control (Attenuator)

When a calibrated gain control attenuator is used, the transducer shall be positioned for a maximum reflection from the reference hole in the secondary standard representing approximately 1/2 the longest inspection distance. This reflection shall be adjusted to mid-scale by varying the gain control accordingly. The difference in decibels between this amplitude and the signal obtained from the first, second, and longest distance reflection obtainable on the secondary standard shall be measured.

The differences shall be recorded and plotted on a curve to determine the necessary correction to the amplitude at the various inspection distances. A level of 80 percent of the primary level obtained from the corrected signal heights, is equivalent to the reject/repair line.

#### 1.11.4 Equipment With Electronic Distance Compensation Circuitry

If the difference in amplitude between the first reflection and the reflection obtained from the maximum inspection distance is 1 dB or less, the instrument may be used as is. If not, the procedure used for equipment with a calibrated decibel control shall be used to determine the necessary correction to the reflections obtained at the various inspection distances.

This characteristic of the equipment shall be re-examined on a monthly basis or as otherwise stated in paragraph EQUIPMENT QUALIFICATION REQUIREMENTS, and correction factors shall be modified accordingly.

#### 1.11.5 Longitudinal Wave Distance-Amplitude Correction Curve

A distance-amplitude correction curve may be used instead of the calibrated gain control or the electronic circuitry for either the shear or longitudinal wave system as described below:

a. A shear wave distance-amplitude correction curve shall be constructed and drawn on the face of the cathode ray tube (CRT) for inspection of weldments in excess of 38 mm (1-1/2 inch) thick when the design of the test equipment permits. The reference hole in the secondary standard SC or DSC shall be used to construct the distance-amplitude correction curve for a minimum of three node points, 1, 2, and 3. The sensitivity of the instrument shall be adjusted to produce 50 percent full-scale response for the maximized primary reflection and the reject/repair line shall be constructed at 80 percent of the established distance-amplitude curve.

b. A longitudinal wave distance-amplitude correction curve shall be constructed and drawn on the face of the CRT when longitudinal waves are to be used in the inspection for material thicknesses exceeding 25 mm, if design of the test equipment permits. The reference hole in the secondary standard shall be used. Instrument sensitivity shall be adjusted to 50 percent full-scale of the maximized response from the reference hole at 1/2 maximum inspection distance. A reject/repair line shall be constructed at 80 percent of the established distance-amplitude curve. The reflection amplitudes to define this curve shall be taken from the faces of the secondary sensitivity standards which are 25 mm (1 inch), 50 mm (2 inch), and 1/2 maximum inspection distance, and the longest distance obtainable from the secondary standard, respectively, from the reference hole. When a correction curve cannot be drawn on the face of the CRT, one of the distance-amplitude correction methods noted above and submitted under the procedure description shall be applied in accordance with paragraph GENERAL REQUIREMENTS.

#### 1.11.6 Longitudinal Wave Inspections Using Immersion Technique

The reference hole in a secondary standard shall be used for each different inspection distance. Repair/reject limits shall be established by immersing both the search unit and secondary standard in the liquid bath in which the inspection is to be conducted. The procedure noted below shall be used:

a. The longitudinal waves from the search unit shall be directed toward the face of the secondary standard closest to the reference hole.

b. The search unit shall be positioned for maximum response. The amplitude of reflection shall be adjusted to 50 percent full-scale. The top of that indication shall be marked on the CRT with a wax pencil or by other means. This establishes the standard reference level. A point at 80 percent of the standard reference level shall be calculated and marked. This locates the reject/repair point. The above shall be repeated for each different surface-to-hole distance to establish the reject/repair line.

c. With the gain at the same setting and the primary standard and search unit in air, a maximized reflection shall be obtained from the 1.524 mm (0.06 inch) reference hole in the primary standard (IIW). Then, this gain setting shall be readjusted to obtain a 50 percent full-scale reflection. The readjusted setting shall be recorded as required by paragraph SUBMITTALS, SD-18 Records, to provide a basis for recalibration

when the secondary standard is unavailable.

## PART 2 PRODUCTS (Not Applicable)

## PART 3 EXECUTION

### 3.1 PREPARATION OF MATERIALS FOR INSPECTION

Surfaces shall be free from the following:

#### 3.1.1 Weld Spatter

Spattering or any roughness that interferes with free movement of the search unit or impairs transmission of the ultrasonic vibrations.

#### 3.1.2 Irregularities

Those which could mask or be confused with defect indications.

#### 3.1.3 Weld Backing Strips

Strips that are not to remain in place shall be removed and all sharp edges and valleys shall be eliminated by grinding or other mechanical means.

#### 3.1.4 Dirt

All loose scale, rust, paint, and dirt shall be removed from the coupling surface.

### 3.2 INSPECTION PROCEDURE

When possible, all welds shall be examined from both sides of the weld and from one surface. If complete inspection cannot be accomplished from one surface, inspection shall be made from another surface that is part of the same joint. Preliminary scanning techniques using an increased instrument gain shall be used to locate possible defects. When possible, gain shall be increased to a minimum of twice (6 dB) the reference level setting. Final acceptance or rejection shall be evaluated with the equipment properly calibrated and the gain control set at the reference level. The reject/repair line shall be used to evaluate quality of the weld. If a periodic calibration check shows that the equipment is not operating properly or that the system's sensitivity has decreased more than 20 percent (2 dB) from the established sensitivity level, all welds inspected since the prior calibration shall be reexamined. If penetration of the shear waves is questionable, the angle search unit shall be placed in position on one side of the weldment with the waves directed through the weldment. A disconnected angle search unit, plastic or metal wedge or disk, or any good reflector shall be placed in the wave path of the search unit on the far side of the weld to reflect the sound. When good reflections cannot be obtained by either shear or longitudinal waves, the Contractor shall modify the procedures in accordance with paragraph GENERAL REQUIREMENTS.

#### 3.2.1 Test Frequency

The test frequency for ferrous materials shall be as specified in AWS D1.1/D1.1M, Section Inspection, subsection Ultrasonic Equipment, except for thicknesses below 13 mm, frequencies between 2.25 and 5 MHz may be used to obtain increased sensitivity. For materials that are difficult to



penetrate, any frequency within the operating range of the equipment may be used. The effective depth of penetration and sound beam divergency shall be demonstrated to the Contracting Officer.

### 3.2.2 Couplants

The choice of couplant is optional with the Contractor, except as follows:

- a. The couplant shall be the same as that used for equipment qualification and calibration.
- b. Couplants that may corrode the reference standards and material being tested or leave objectionable residues shall not be used.
- c. Oils shall not be used in systems intended to handle liquid oxygen.
- d. Couplants shall be of the proper viscosity to give good coupling for the surface roughness.

### 3.2.3 Shear Wave Inspection

Shear wave inspection shall be performed as follows: The search unit shall be placed on the contact surface at a distance from the weld equal to that used when calibrating the equipment.

### 3.2.4 Longitudinal Flaws

To detect longitudinal flaws, the search unit shall be slowly moved toward and away from the weld far enough to cover its entire cross section, approximately 90 degrees to the weld centerline. The search unit shall be radially oscillated to the left and right, covering an angle of approximately 30 degrees. During the foregoing movement, the search unit shall be continually advanced parallel to the weld centerline. The rate of movement shall depend on the operator's ability to clearly see and identify all reflections. The amount of movement shall be calculated to ensure that the inspection distance will be great enough to traverse the weld.

### 3.2.5 Transverse Flaws

To detect transverse flaws when the welded surface is ground flush, the search unit shall be moved along the welded surface in each direction parallel to the centerline of the weld metal with the wave radiating parallel to the weld centerline. To detect transverse flaws when the welded surface is not ground flush, the search unit shall be moved parallel to the weld in each direction, on the adjacent base metal at the top of the weld, with the wave directed at an angle of 30 degrees to the weld centerline.

### 3.2.6 Longitudinal Wave Inspection

This inspection shall be made as follows:

- a. The search unit shall be placed on the contact surface with the wave directed in a straight line through any intervening base metal and through the weldment.
- b. The search unit shall then be moved slowly in a direction parallel to the weld centerline and zigzagged across an area equivalent to the welded thickness to make sure that waves penetrate the entire welded cross

section.

c. The rate of movement shall be dependent on the operator's ability to clearly see and identify all reflections.

### 3.3 GENERAL ACCEPTANCE/REJECTION REQUIREMENTS

Discontinuities shall be evaluated only when the ultrasonic equipment is calibrated properly. If discontinuities are detected, the sound beam shall be directed to maximize the signal amplitude. To determine the length of a discontinuity, the search unit shall be moved parallel to the discontinuity axis in both directions from the position of maximum signal amplitude. One-half the amplitude or a 6-dB increase in sensitivity from a point at which the discontinuity signal drops rapidly to the baseline shall be defined as the extremity of the discontinuity. At this point, the scanning surface shall be marked at the position indicated by the center of the transducer. This shall be repeated to determine the other extremity. The length of the discontinuity shall be defined as the distance between these two marks. For discontinuities with signal amplitudes exceeding full screen height, 50 percent of full screen shall be considered half-peak amplitude. At this point, the scanning surface shall be marked at the position indicated by the center of the transducer. This shall be repeated to determine the other extremity. The length of the discontinuity shall be defined as the distance between these two marks. The maximum signal amplitude, length, depth, and position within the inspection zone shall be determined and reported for discontinuities yielding a signal amplitude equal to or exceeding the reject/repair line. The minimum recordable length of a discontinuity shall be 3 mm. When evaluating welds joining two members with different thicknesses at the weld, the thickness T shall be the lesser of the two thicknesses. The criteria for acceptance or rejection based on ultrasonic inspection will supplement a visual inspection. The sizes and surface conditions of the welds shall conform to the requirements indicated on the applicable plans and drawings and other sections of the specification. When ultrasonic inspection is used along with radiography, the limits specified under paragraph REFERENCE STANDARDS FOR EQUIPMENT, QUALIFICATIONS, AND CALIBRATION shall supplement the radiographic standards.

#### 3.3.1 Investigation of Questionable Indications

An indication considered doubtful shall be brought to the attention of the Contracting Officer and, at the Contractor's option, the weld shall be repaired or investigated further. Indications detected within 10 mm of accessible surfaces shall be investigated further using liquid penetrant in accordance with ASTM E 165 or magnetic particle methods in accordance with ASTM E 709, as applicable, to determine if the surface is penetrated. Failure to locate the flaws by one of these methods shall necessitate further investigation by the other. For nonmagnetic materials, only dye penetrant inspection is required. Other questionable defects shall be further investigated using modifications of the inspection procedure in accordance with paragraph GENERAL REQUIREMENTS.

#### 3.3.2 Inspection of Repairs

All repairs shall undergo the same inspection procedure that originally revealed the discontinuities. Before acceptance, the welds shall meet the standards required for the original weld.

### 3.4 ACCEPTANCE/REJECTION LIMITS

Welds shall be accepted or rejected by ultrasonic indication in accordance with the following:

#### 3.4.1 Full Penetration Butt Joints and Corner Joints

##### 3.4.1.1 Class III

Welds shall be rejected on the basis of the following:

a. Any discontinuity with a reflection exceeding the established reject/repair line and with a length exceeding 13 mm. Adjacent discontinuities separated by sound metal with a dimension less than twice the length of the longest discontinuity shall be considered a single discontinuity.

b. Any discontinuity with a reflection greater than or equal to 50 percent of the reject/repair line, or with the level 8 dB more than the reject/repair line, and with a length (L) exceeding 50 mm or LT, whichever is greater.

c. If the total cumulative length of discontinuities in any 300 mm of weld length exceeds 75 mm or 2 T, whichever is greater, that weld length shall be rejected.

#### 3.4.2 Full Penetration Tee Joints

Full Penetration Tee Joints (for Incomplete Root Penetration): Any discontinuity with the reflection exceeding the established reject/repair line of the applicable class shall be rejected. Any discontinuity with a reflection exceeding 25 percent of the established reject/repair line, up to and including the reject/repair line, shall be rejected if its length exceeds 1/2 T in a direction transverse to the axis of the weld or LT parallel to the axis for all classes. If the total cumulative length of discontinuities in any 300 mm of weld length exceeds the limits of the applicable class, that weld length shall be rejected.

#### 3.4.3 Partial and Full Penetration Tee Joints

Partial and Full Penetration Tee Joint Boundaries: The depth of weld penetration and weld cross section width at the through member surface shall be as indicated by applicable plans or drawings. Limits of discontinuities shall be as specified in preceding paragraphs.

#### 3.4.4 Tee Joint Discontinuities

Tee joint discontinuities extending into the through member shall be rejected if reflection amplitude is in the range of minus 6 dB of the reject/repair line and the discontinuity extends more than 1.6 mm or more into the through plate.

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STRUCTURAL STEEL  
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PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC FCD	(1995a) Quality Certification Program Description
AISC 316	(1989) ASD Manual of Steel Construction
AISC 317	(1992; Errata 1994) Connections
AISC 326	(1983) Detailing for Steel Construction
AISC 303	(2000) Steel Buildings and Bridges
AISC 348	(1985) Allowable Stress Design Specification for Structural Joints Using ASTM A325 or A490 Bolts
AISC 335	(1989) Structural Steel Buildings Allowable Stress Design and Plastic Design
AISC S340	(1992) Metric Properties of Structural Shapes with Dimensions According to ASTM A6M

ASME INTERNATIONAL (ASME)

ASME B46.1	(1995) Surface Texture, (Surface Roughness, Waviness, and Lay)
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AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 6/A 6M	(1998a) General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling
ASTM A 36/A 36M	(1997; Rev. A) Carbon Structural Steel
ASTM A 123/A 123M	(2000) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 143	(1974; R 1994) Safeguarding Against Embrittlement of Hot-Dip Galvanized

	Structural Steel Products and Procedure for Detecting Embrittlement
ASTM A 153/A 153M	(1998) Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 307	(1997) Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength
ASTM A 325M	(1997) High-Strength Bolts for Structural Steel Joints (Metric)
ASTM A 500	(1999) Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A 501	(1999) Hot-Formed Welded and Seamless Carbon Steel Structural Tubing
ASTM A 780	(1993; Rev. A) Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
ASTM A 992/A 992M	(1998e1) Steel for Structural Shapes for Use in Building Framing
ASTM C 827	(1995; R 1997) Change in Height at Early Ages of Cylindrical Specimens from Cementitious Mixtures
ASTM C 1107	(1999) Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
ASTM F 844	(1998) Washers, Steel, Plain (Flat), Unhardened for General Use
ASTM F 959M	(1999; Rev. A) Compressible-Washer-Type Direct Tension Indicators for Use with Structural Fasteners (Metric)

## AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M	(2000) Structural Welding Code - Steel
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## STEEL STRUCTURES PAINTING COUNCIL (SSPC)

SSPC SP 3	(1995) Power Tool Cleaning
SSPC SP 6	(1994) Commercial Blast Cleaning
SSPC Paint 25	(1991) Red Iron Oxide, Zinc Oxide, Raw Linseed Oil and Alkyd Primer (Without Lead and Chromate Pigments)
SSPC PA 1	(1991) Shop, Field, and Maintenance Painting
SSPC PS 13.01	(1991) Epoxy-Polyamide Painting System



## 1.2 SYSTEM DESCRIPTION

Provide the structural steel system, including shop primer, complete and ready for use. Structural steel systems including design, materials, installation, workmanship, fabrication, assembly, erection, inspection, quality control, and testing shall be provided in accordance with AISC 316 and AISC 317 except as modified in this contract.

## 1.3 MODIFICATIONS TO REFERENCES

In AISC 316, AISC 317, AISC 335, AISC 303, AISC 348, and AISC S340, except as modified in this section, shall be considered a part of AISC 316 and AISC 317 and is referred to in this section as AISC 316 and AISC 317.

## 1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

### SD-02 Shop Drawings

Erection drawings, G-AO

Erection drawings, including description of temporary supports.

Fabrication drawings, G-AO

Fabrication drawings, including description of connections.

### SD-03 Product Data

Shop primer

Load indicator washers

Include test report for Class B primer.

### SD-06 Test Reports

Class B coating

Bolts, nuts, and washers

Supply the certified manufacturer's mill reports which clearly show the applicable ASTM mechanical and chemical requirements together with the actual test results for the supplied fasteners.

### SD-07 Certificates

Steel

Bolts, nuts, and washers

Shop primer

Welding electrodes and rods

Nonshrink grout

Galvanizing

AISC Quality Certification

Welding procedures and qualifications

#### 1.5 AISC QUALITY CERTIFICATION

Work shall be fabricated in an AISC certified fabrication plant with a Category as required by the Contracting Officer.

#### 1.6 QUALITY ASSURANCE

##### 1.6.1 Drawing Requirements

Submit fabrication drawings for approval prior to fabrication. Prepare in accordance with AISC 326, AISC 316 and AISC 317. Drawings shall not be reproductions of contract drawings. Include complete information for the fabrication and erection of the structure's components, including the location, type, and size of bolts, welds, member sizes and lengths, connection details, blocks, copes, and cuts. Use AWS standard welding symbols. Shoring and temporary bracing shall be designed and sealed by a registered professional engineer and submitted for record purposes, with calculations, as part of the drawings.

##### 1.6.2 Certifications

###### 1.6.2.1 Overhead, Top Running Crane Rail Beam

Submit written field survey results for overhead, top running crane rail beam verifying tolerance requirements, area out of tolerance and proposed corrective measures.

###### 1.6.2.2 Erection Plan

Submit for record purposes. Indicate the sequence of erection, temporary shoring and bracing, and a detailed sequence of welding, including each welding procedure required.

###### 1.6.2.3 Welding Procedures and Qualifications

Prior to welding, submit certification for each welder stating the type of welding and positions qualified for, the code and procedure qualified under, date qualified, and the firm and individual certifying the qualification tests. If the qualification date of the welding operator is more than one-year old, the welding operator's qualification certificate shall be accompanied by a current certificate by the welder attesting to the fact that he has been engaged in welding since the date of certification, with no break in welding service greater than 6 months.

## PART 2 PRODUCTS

### 2.1 STEEL

#### 2.1.1 Structural Steel

ASTM A 36/A 36M.

## 2.1.2 High-Strength Structural Steel

### 2.1.2.1 Low-Alloy Steel

ASTM A 992/A 992M Grade 345.

## 2.1.3 Structural Shapes for Use in Building Framing

Wide flange shapes, ASTM A 992/A 992M.

## 2.1.4 Structural Steel Tubing

ASTM A 500, Grade B.

## 2.1.5 Steel Pipe

ASTM A 53/A53M or ASTM A 501, Type E or S, Grade B.

## 2.2 BOLTS, NUTS, AND WASHERS

Provide the following unless indicated otherwise.

### 2.2.1 Structural Steel, Steel Pipe

#### 2.2.1.1 Bolts

ASTM A 307, Grade A; ASTM A 325M, Type 1. The bolt heads and the nuts of the supplied fasteners must be marked with the manufacturer's identification mark, the strength grade and type specified by ASTM specifications.

#### 2.2.1.2 Nuts

ASTM A 563M, Grade A, heavy hex style, except nuts under M36 may be provided in hex style.

#### 2.2.1.3 Washers

ASTM F 844 washers for ASTM A 307 bolts, and ASTM F 436M washers for ASTM A 325M and ASTM A 490M bolts.

### 2.2.2 High-Strength Structural Steel and Structural Steel Tubing

#### 2.2.2.1 Nuts

ASTM A 563M, Grade and Style as specified in the applicable ASTM bolt standard.

#### 2.2.2.2 Washers

ASTM F 436M, plain carbon steel.

### 2.2.3 Foundation Anchorage

#### 2.2.3.1 Bolts

ASTM A 307.

#### 2.2.3.2 Nuts

ASTM A 563, Grade A, hex style.

#### 2.2.3.3 Washers

ASTM F 844.

#### 2.2.4 Load Indicator Washers

ASTM F 959M.

#### 2.2.5 Self-Locking Nuts

Provide nuts with a locking pin set in the nut. The locking pin shall slide along the bolt threads, and by reversing the direction of the locking pin, the nut shall be removed without damaging the nut or bolt. Provide stainless steel locking pins.

### 2.3 STRUCTURAL STEEL ACCESSORIES

#### 2.3.1 Welding Electrodes and Rods

AWS D1.1/D1.1M.

#### 2.3.2 Nonshrink Grout

ASTM C 1107, with no ASTM C 827 shrinkage.

#### 2.3.3 Welded Shear Stud Connectors

AWS D1.1/D1.1M.

### 2.4 SHOP PRIMER

SSPC Paint 25, (alkyd primer) or SSPC PS 13.01 epoxy-polyamide, green primer (Form 150) type 1, except provide a Class B coating in accordance with AISC 316 and AISC 317 for slip critical joints. Primer shall conform to Federal, State, and local VOC regulations. If flash rusting occurs, re-clean the surface prior to application of primer.

### 2.5 GALVANIZING

ASTM A 123/A 123M or ASTM A 153/A 153M, as applicable, unless specified otherwise galvanize after fabrication where practicable.

### 2.6 FABRICATION

#### 2.6.1 Markings

Prior to erection, members shall be identified by a painted erection mark. Connecting parts assembled in the shop for reaming holes in field connections shall be match marked with scratch and notch marks. Do not locate erection markings on areas to be welded. Do not locate match markings in areas that will decrease member strength or cause stress concentrations.

## 2.6.2 Shop Primer

Shop prime structural steel, except as modified herein, in accordance with SSPC PA 1. Do not prime steel surfaces embedded in concrete, galvanized surfaces, surfaces to receive sprayed-on fireproofing, surfaces designed as part of a composite steel concrete section, or surfaces within 13 mm of the toe of the welds prior to welding (except surfaces on which metal decking is to be welded). Slip critical surfaces shall be primed with a Class B coating. Prior to assembly, prime surfaces which will be concealed or inaccessible after assembly. Do not apply primer in foggy or rainy weather; when the ambient temperature is below 7 degrees C or over 35 degrees C; or when the primer may be exposed to temperatures below 4 degrees C within 48 hours after application, unless approved otherwise by the Contracting Officer.

### 2.6.2.1 Cleaning

SSPC SP 6, except steel exposed in spaces above ceilings, attic spaces, furred spaces, and chases that will be hidden to view in finished construction may be cleaned to SSPC SP 3 when recommended by the shop primer manufacturer. Maintain steel surfaces free from rust, dirt, oil, grease, and other contaminants through final assembly.

### 2.6.2.2 Primer

Apply primer to a minimum dry film thickness of 0.05 mm except provide the Class B coating for slip critical joints in accordance with the coating manufacturer's recommendations. Repair damaged primed surfaces with an additional coat of primer.

## 2.6.3 Fireproofing Coated Surfaces

Surfaces to receive sprayed-on fireproofing coatings shall be cleaned and prepared in accordance with the manufacturer's recommendations, and as specified in Section 07810N, "Spray-Applied Fireproofing".

## 2.6.4 Surface Finishes

ASME B46.1 maximum surface roughness of 125 for pin, pinholes, and sliding bearings, unless indicated otherwise.

# PART 3 EXECUTION

## 3.1 FABRICATION

Fabrication shall be in accordance with the applicable provisions of AISC 316. Fabrication and assembly shall be done in the shop to the greatest extent possible. The fabricating plant shall be certified under the AISC FCD for Category A structural steelwork. Compression joints depending on contact bearing shall have a surface roughness not in excess of 13 micrometer as determined by ASME B46.1, and ends shall be square within the tolerances for milled ends specified in ASTM A 6/A 6M. Structural steelwork, except surfaces of steel to be encased in concrete, surfaces to be field welded, surfaces to be fireproofed, and contact surfaces of friction-type high-strength bolted connections shall be prepared for painting in accordance with endorsement "P" of AISC FCD and primed with the specified paint.

## 3.2 ERECTION

- a: Erection of structural steel, except as indicated in item b. below, shall be in accordance with the applicable provisions of AISC 316. Erection plan shall be reviewed, stamped and sealed by a licensed structural engineer.

Provide for drainage in structural steel. After final positioning of steel members, provide full bearing under base plates and bearing plates using nonshrink grout. Place nonshrink grout in accordance with the manufacturer's instructions.

### 3.2.1 STORAGE

Material shall be stored out of contact with the ground in such manner and location as will minimize deterioration.

### 3.3 CONNECTIONS

Except as modified in this section, connections not detailed shall be designed in accordance with AISC 335. Build connections into existing work. Do not tighten anchor bolts set in concrete with impact torque wrenches. Punch, subpunch and ream, or drill bolt holes. Bolts, nuts, and washers shall be clean of dirt and rust, and lubricated immediately prior to installation.

#### 3.3.1 Common Grade Bolts

ASTM A 307 bolts shall be tightened to a "snug tight" fit. "Snug tight" is the tightness that exists when plies in a joint are in firm contact. If firm contact of joint plies cannot be obtained with a few impacts of an impact wrench, or the full effort of a man using a spud wrench, contact the Contracting Officer for further instructions.

#### 3.3.2 High-Strength Bolts

ASTM A 325M and ASTM A 490M bolts shall be fully tensioned to 70 percent of their minimum tensile strength. Provide load indicator bolts or washers in all ASTM A 325M bolted connections, except provide only load indicator washers for slip critical connections. Direct tension indicator tightening, shall be the only acceptable tightening methods. Use only direct tension indicator tightening for slip critical connections. Bolts shall be installed in connection holes and initially brought to a snug tight fit. After the initial tightening procedure, bolts shall then be fully tensioned, progressing from the most rigid part of a connection to the free edges.

##### 3.3.2.1 Installation of Load Indicator Washers (LIW)

ASTM F 959M. Where possible, the LIW shall be installed under the bolt head and the nut shall be tightened. If the LIW is installed adjacent to the turned element, provide a flat ASTM F 436M washer between the LIW and nut when the nut is turned for tightening, and between the LIW and bolt head when the bolt head is turned for tightening. In addition to the LIW, provide flat ASTM F 436M washers under both the bolt head and nut when ASTM A 490M bolts are used.

### 3.4 WELDING

AWS D1.1/D1.1M, except use only shielded metal arc welding and low hydrogen

electrodes for ASTM A 514/A 514M steel. Do not stress relieve ASTM A 514/A 514M steel by heat treatment. Grind all exposed welds smooth. Provide AWS D1.1/D1.1M qualified welders, welding operators, and tackers.

The contractor shall develop and submit the Welding Procedure Specifications (WPS) for all welding, including welding done using prequalified procedures. Prequalified procedures may be submitted for information only; however, procedures that are not prequalified shall be submitted for approval.

#### 3.4.1 Removal of Temporary Welds, Run-Off Plates, and Backing Strips

Remove only from finished areas.

### 3.5 SHOP PRIMER REPAIR

Repair shop primer in accordance with the paint manufacturer's recommendation for surfaces damaged by handling, transporting, cutting, welding, or bolting.

#### 3.5.1 Field Priming

Field priming of steel exposed to the weather, or located in building areas without HVAC for control of relative humidity. After erection, the field bolt heads and nuts, field welds, and any abrasions in the shop coat shall be cleaned and primed with paint of the same quality as that used for the shop coat.

### 3.6 GALVANIZING REPAIR

Provide as indicated or specified. Galvanize after fabrication where practicable. Repair damage to galvanized coatings using ASTM A 780 zinc rich paint for galvanizing damaged by handling, transporting, cutting, welding, or bolting. Do not heat surfaces to which repair paint has been applied.

### 3.7 FIELD QUALITY CONTROL

Perform field tests, and provide labor, equipment, and incidentals required for testing, except that electric power for field tests will be furnished as set forth in Division 1. The Contracting Officer shall be notified in writing of defective welds, bolts, nuts, and washers within 7 working days of the date of weld inspection.

#### 3.7.1 Welds

##### 3.7.1.1 Visual Inspection

AWS D1.1/D1.1M. Furnish the services of AWS-certified welding inspectors for fabrication and erection inspection and testing and verification inspections. Welding inspectors shall visually inspect and mark welds, including fillet weld end returns.

##### 3.7.1.2 Nondestructive Testing

AWS D1.1/D1.1M. Test locations shall be complete penetration welds at HSS members in the court area and moment connections in the HQ Beddown Building. The primary focus of the inspection shall be the frame cap-pieces in the Court Area and the second floor area of the HQ Beddown

Building. The particular welds to be inspected shall be at the discretion of the Corps Field Engineer. If more than 20 percent of welds made by a welder contain defects identified by testing, then all welds made by that welder shall be tested by radiographic or ultrasonic testing, as approved by the Contracting Officer. When all welds made by an individual welder are required to be tested, magnetic particle testing shall be used only in areas inaccessible to either radiographic or ultrasonic testing. Retest defective areas after repair.

- a. Testing frequency: Provide the following types and number of tests:

<u>Test Type</u>	<u>Number of Tests</u>
Radiographic	0
Ultrasonic	15 Percent of all welds specified above
Magnetic Particle	0
Dye Penetrant	0

### 3.7.2 Load Indicator Washers

#### 3.7.2.1 Load Indicator Washer Compression

Load indicator washers shall be tested in place to verify that they have been compressed sufficiently to provide the 0.38 mm gap when the load indicator washer is placed under the bolt head and the nut is tightened, and to provide the 0.13 mm gap when the load indicator washer is placed under the turned element, as required by ASTM F 959M.

#### 3.7.2.2 Load Indicator Gaps

In addition to the above testing, an independent testing agency as approved by the Contracting Officer, shall test in place the load indicator gapson 20 percent of the installed load indicator washers to verify that the ASTM F 959M load indicator gaps have been achieved. If more than 10 percent of the load indicators tested have not been compressed sufficiently to provide the average gaps required by ASTM F 959M, then all in place load indicator washers shall be tested to verify that the ASTM F 959M load indicator gaps have been achieved. Test locations shall be selected by the Contracting Officer.

### 3.7.3 High-Strength Bolts

#### 3.7.3.1 Testing Bolt, Nut, and Washer Assemblies

Test a minimum of 3 bolt, nut, and washer assemblies from each mill certificate batch in a tension measuring device at the job site prior to the beginning of bolting start-up. Demonstrate that the bolts and nuts, when used together, can develop tension not less than the provisions specified in AISC 348, Table 4, depending on bolt size and grade. The bolt tension shall be developed by tightening the nut. A representative of the manufacturer or supplier shall be present to ensure that the fasteners are properly used, and to demonstrate that the fastener assemblies supplied satisfy the specified requirements.



### 3.7.3.2 Inspection

Inspection procedures shall be in accordance with AISC 348, Section 9. Confirm and report to the Contracting Officer that the materials meet the project specification and that they are properly stored. Confirm that the faying surfaces have been properly prepared before the connections are assembled. Observe the specified job site testing and calibration, and confirm that the procedure to be used provides the required tension. Monitor the work to ensure the testing procedures are routinely followed on joints that are specified to be fully tensioned.

### 3.7.3.3 Testing

The Government has the option to perform nondestructive tests on 5 percent of the installed bolts to verify compliance with pre-load bolt tension requirements. The nondestructive testing will be done in-place using an ultrasonic measuring device or any other device capable of determining in-place pre-load bolt tension. The test locations shall be selected by the Contracting Officer. If more than 10 percent of the bolts tested contain defects identified by testing, then all bolts used from the batch from which the tested bolts were taken, shall be tested. Retest new bolts after installation.

### 3.7.4 Testing for Embrittlement

ASTM A 143 for steel products hot-dip galvanized after fabrication.

-- End of Section --

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DIVISION 05 - METALS

SECTION 05300

STEEL DECKING

**01/02**

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## SECTION 05300

STEEL DECKING  
01/02

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC 335 (1989) Specification for Structural Steel Buildings - Allowable Stress Design, Plastic Design

## AMERICAN IRON AND STEEL INSTITUTE (AISI)

AISI SG-973 (1996) Cold-Formed Steel Design Manual

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 611 (1997) Structural Steel (SS), Sheet, Carbon, Cold-Rolled

ASTM A 653/A 653M (2000) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

ASTM A 780 (2000) Repair of Damaged and Uncoated Areas of Hot-Dipped Galvanized Coatings

ASTM A 792/A 792M (1999) Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process

## AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M (2000) Structural Welding Code - Steel

AWS D1.3 (1998) Structural Welding Code - Sheet Steel

## STEEL DECK INSTITUTE (SDI)

SDI DDM01 (1991) Diaphragm Design Manual

SDI 30 (1995) Design Manual for Composite Decks, Form Decks, Roof Decks, and Cellular Metal Floor Deck with Electrical Distribution

## THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC Paint 20 (1991) Zinc-Rich Primers (Type I -

"Inorganic" and Type II - "Organic")

## 1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

### SD-02 Shop Drawings

Deck Units; G, AE.  
Accessories; G, AE.  
Attachments; G, AE.  
Holes and Openings; G, AE.

Drawings shall include type, configuration, structural properties, location, and necessary details of deck units, accessories, and supporting members; size and location of holes to be cut and reinforcement to be provided; location and sequence of welded connections; and the manufacturer's erection instructions.

### SD-03 Product Data

Deck Units; G, AE.

Design computations for the structural properties of the deck units or SDI certification that the units are designed in accordance with SDI specifications.

Attachments; G, AE.

Prior to welding operations, copies of qualified procedures and lists of names and identification symbols of qualified welders and welding operators.

### SD-04 Samples

Deck Units; G, AO.  
Accessories; G, AO.

A 0.19 sq meter sample of the decking material to be used, along with a sample of each of the accessories used. A sample of acoustical material to be used shall be included.

### SD-07 Certificates

Deck Units; G, AO.  
Attachments; G, AO.

Manufacturer's certificates attesting that the decking material meets the specified requirements. Manufacturer's certificate attesting that the operators are authorized to use the low-velocity piston tool.

## 1.3 DELIVERY, STORAGE, AND HANDLING

Deck units shall be delivered to the site in a dry and undamaged condition,

stored off the ground with one end elevated, and stored under a weathertight covering permitting good air circulation. Finish of deck units shall be maintained at all times by using touch-up paint whenever necessary to prevent the formation of rust.

## PART 2 PRODUCTS

### 2.1 DECK UNITS

Deck units shall conform to SDI 30. Panels of maximum possible lengths shall be used to minimize end laps. Deck units shall be fabricated in lengths to span 3 or more supports with flush, telescoped, or nested 50 mm laps at ends, and interlocking, or nested side laps, unless otherwise indicated. Deck with cross-sectional configuration differing from the units indicated may be used, provided that the properties of the proposed units, determined in accordance with AISI SG-973, are equal to or greater than the properties of the units indicated and that the material will fit the space provided without requiring revisions to adjacent materials or systems.

#### 2.1.1 Roof Deck

Steel deck used in conjunction with insulation and built-up roofing shall conform to ASTM A 792/A 792M, ASTM A 611 or ASTM A 792/A 792M. Roof deck units shall be fabricated of the steel design thickness required by the design drawings and shall be galvanized.

#### 2.1.2 Composite Deck

Deck to receive concrete as a filler or for composite deck assembly shall conform to ASTM A 653/A 653M or ASTM A 611. Deck used as the tension reinforcing in composite deck shall be fabricated of the steel design thickness required by the design drawings, and shall be zinc-coated in conformance with ASTM A 653/A 653M. Deck units used in composite deck shall have adequate embossment to develop mechanical shear bond to provide composite action between the deck and the concrete.

#### 2.1.3 Form Deck

Deck used as a permanent form for concrete shall conform to ASTM A 653/A 653M or ASTM A 611. Deck used as a form for concrete shall be fabricated of the steel design thickness required by the design drawings, and shall be zinc-coated in conformance with ASTM A 653/A 653M.

#### 2.1.4 Shear Connectors

Shear connectors shall be headed stud type, ASTM A 108, Grade 1015 or 1020, cold finished carbon steel with dimensions complying with AISC 335.

### 2.2 TOUCH-UP PAINT

Touch-up paint for shop-painted units shall be of the same type used for the shop painting, and touch-up paint for zinc-coated units shall be an approved galvanizing repair paint with a high-zinc dust content. Welds shall be touched-up with paint conforming to SSPC Paint 20 in accordance with ASTM A 780. Finish of deck units and accessories shall be maintained by using touch-up paint whenever necessary to prevent the formation of rust.

### 2.3 ADJUSTING PLATES

Adjusting plates or segments of deck units shall be provided in locations too narrow to accommodate full-size units. As far as practical, the plates shall be the same thickness and configuration as the deck units.

## 2.4 CLOSURE PLATES

### 2.4.1 Closure Plates for Roof Deck

Voids above interior walls shall be closed with sheet metal where shown. Open deck cells at parapets, end walls, eaves, and openings through roofs shall be closed with sheet metal. Sheet metal shall be same thickness as deck units.

### 2.4.2 Closure Plates Deck

The concrete shall be supported and retained at each floor level. Provide edge closures at all edges of the slab of sufficient strength and stiffness to support the wet concrete. Metal closures shall be provided for all openings in csteel deck 6 mm and over, including but not limited to:

#### 2.4.2.1 Cover Plates to Close Panels

Cover plates to close panel edge and end conditions and where panels change direction or abut. Butt joints in composite steel deck may receive a tape joint cover.

#### 2.4.2.2 Column Closures to Close Openings

Column closures to close openings between steel deck and structural steel columns.

#### 2.4.2.3 Sheet Metal

Where deck is cut for passage of pipes, ducts, columns, etc., and deck is to remain exposed, provide a neatly cut sheet metal collar to cover edges of deck. Do not cut deck until after installation of supplemental supports.

## 2.5 ACCESSORIES

The manufacturer's standard accessories shall be furnished as necessary to complete the deck installation. Metal accessories shall be of the same material as the deck and have minimum design thickness as follows: saddles, 1.204 mm (0.0474 inch); welding washers, 1.519 mm (0.0598 inch); cant strip, 0.749 mm (0.0295 inch); other metal accessories, 0.909 mm (0.0358 inch); unless otherwise indicated. Accessories shall include but not be limited to saddles, welding washers, cant strips, butt cover plates, underlapping sleeves, and ridge and valley plates.

## PART 3 EXECUTION

### 3.1 ERECTION

Erection of deck and accessories shall be in accordance with SDI 02 and the approved detail drawings. Damaged deck and accessories including material which is permanently stained or contaminated, with burned holes or deformed shall not be installed. The deck units shall be placed on secure supports, properly adjusted, and aligned at right angles to supports before being permanently secured in place. The deck shall not be filled with concrete,

used for storage or as a working platform until the units have been secured in position. Loads shall be distributed by appropriate means to prevent damage during construction and to the completed assembly. The maximum uniform distributed storage load shall not exceed the design live load. There shall be no loads suspended directly from the steel deck.

### 3.2 SHORING

Shoring requirements for placing and curing of concrete shall be as shown on the Design Drawings.

### 3.3 ATTACHMENTS

All fasteners shall be installed in accordance with the manufacturer's recommended procedure, except as otherwise specified. The deck units shall be welded with nominal 16 mm diameter puddle welds or fastened with screws, powder-actuated fasteners or pneumatically driven fasteners to supports as indicated on the design drawings and in accordance with requirements of SDI 30. All welding of steel deck shall be in accordance with AWS D1.3 using methods and electrodes as recommended by the manufacturer of the steel deck being used. Welds shall be made only by operators previously qualified by tests prescribed in AWS D1.3 to perform the type of work required. Welding washers shall be used at the connections of the deck to supports if indicated on Design Drawings. Welding washers shall not be used at sidelaps. Holes and similar defects will not be acceptable. Deck ends shall be lapped 50 mm. All partial or segments of deck units shall be attached to structural supports in accordance with Section 2.5 of SDI DDM01.

Powder-actuated fasteners shall be driven with a low-velocity piston tool by an operator authorized by the manufacturer of the piston tool. Pneumatically driven fasteners shall be driven with a low-velocity fastening tool and shall comply with the manufacturer's recommendations. Shear connectors shall be attached as shown and shall be welded as per AWS D1.1/D1.1M through the steel deck to the steel member.

### 3.4 HOLES AND OPENINGS

All holes and openings required shall be coordinated with the drawings, specifications, and other trades. Holes and openings shall be drilled or cut, reinforced and framed as indicated on the drawings or described in the specifications and as required for rigidity and load capacity. Holes and openings less than 150 mm across require no reinforcement. Holes and openings 150 to 300 mm across shall be reinforced by 1.204 mm (0.0474 inch) thick steel sheet at least 300 mm wider and longer than the opening and be fastened to the steel deck at each corner of the sheet and at a maximum of 150 mm on center. Holes and openings larger than 300 mm shall be reinforced by steel angles installed perpendicular to the steel joists and supported by the adjacent steel joists. Steel angles shall be installed perpendicular to the deck ribs and shall be fastened to the angles perpendicular to the steel joists. Openings must not interfere with seismic members such as chords and drag struts.

### 3.5 PREPARATION OF FIRE-PROOFED SURFACES

Deck surfaces, both composite and noncomposite, which are to receive sprayed-on fireproofing, shall be galvanized and shall be free of all grease, mill oil, paraffin, dirt, salt, and other contaminants which impair adhesion of the fireproofing. Any required cleaning shall be done prior to steel deck installation using a cleaning method that is compatible with the sprayed-on fireproofing.



-- End of Section --

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SECTION 05400

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**01/02**

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## SECTION 05400

## COLD-FORMED STEEL FRAMING

**01/02**

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 370	(1997a) Mechanical Testing of Steel Products
ASTM A 653/A 653M	(2000) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM C 955	(2000a) Load-Bearing (Transverse and Axial) Steel Studs, Runners (Tracks), and Bracing or Bridging for Screw Application of Gypsum Panel Products and Metal Plaster Bases
ASTM E 329	(2000b) Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction

## AMERICAN WELDING SOCIETY (AWS)

AWS D1.3	(1998) Structural Welding Code - Sheet Steel
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## 1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

## SD-02 Shop Drawings

Framing Components (Exterior Studs); G, AE.

- a. Cross sections, plans, and/or elevations showing component types and locations for each framing application; including shop coatings and material thicknesses for each framing component.

b. Connection details showing fastener type, quantity, location, and other information to assure proper installation.

c. Drawings depicting panel configuration, dimensions, components, locations, and construction sequence if the Contractor elects to install prefabricated/prefinished frames.

#### SD-07 Certificates

Mill Certificates; G, AO.

Mill certificates or test reports from independent testing agency, qualified in accordance with ASTM E 329, showing that the steel sheet used in the manufacture of each cold-formed component complies with the minimum yield strengths and uncoated steel thickness specified. Test reports shall be based on the results of three coupon tests in accordance with ASTM A 370.

Welds; G, AO.

Certified copies of welder qualifications test records showing qualification in accordance with AWS D1.3.

### 1.3 DELIVERY, HANDLING AND STORAGE

Materials shall be delivered and handled preventing bending or other damage, and avoiding contact with soil or other contaminating materials. Finish of the framing members shall be maintained at all times, using an approved high zinc dust content, galvanizing repair paint whenever necessary to prevent the formation of rust.

## PART 2 PRODUCTS

### 2.1 STEEL STUDS, TRACKS, BRACING, BRIDGING, AND ACCESSORIES

Framing components shall comply with ASTM C 955 and the following:

- a. Material shall be corrosion-resistant steel complying with ASTM A 653/A 653M, Grade 230 or higher, having a minimum yield of 230 MPa and a G 60 minimum zinc coating.
- b. Minimum uncoated steel thickness (design thickness times 0.95):
  - (1). Studs and Tracks: 16 ga .
  - (2). Bridging: Standard thickness as provided by the Manufacturer.
  - (3). Bracing: As indicated.
  - (3). Accessories: Standard thickness as provided by the manufacturer.
- c. Stud and Track web depth: As indicated .
- d. Stud flange width: 41 mm .
- e. Interior stud effective section properties:

6 inch x 14 Ga. CFMF stud properties (152 mm x 14 Ga) Flange width = 64 mm

Ix=	4.600 in.^4	1914665 mm^4
Sx=	1.554 in.^3	25465 mm^3
Rx=	2.352 in	60 mm
Iy=	0.689 in^4	286783 mm^4
Sy=	0.397 in^3	6506 mm^3
Ry=	0.910 in.	23 mm

3-5/8 inch x 16 GA. CFMF stud properties (92 mm x 16 Ga.)

Ix=	0.863 in.^4	359208 mm^4
Sx=	0.483 in.^3	7915 mm^3
Rx=	1.413 in	36 mm
Iy=	0.168 in^4	69927 mm^4
Sy=	0.160 in^3	2622 mm^3
Ry=	0.624 in.	16 mm

f. Structural stud section properties are indicated on the Drawings.

## 2.2 MARKINGS

Studs and track shall have product markings on the web of the section. The markings shall be repeated throughout the length of the member at a maximum spacing of 1200 mm on center and shall be legible and easily read. The product marking shall include the following:

- a. Manufacturer's identification.
- b. Minimum delivered uncoated steel thickness.
- c. Protective coating designator.
- d. Minimum yield strength.

## 2.3 CONNECTIONS

Attach components by welding. Secure cold formed metal framing to supporting structure as indicated on the drawings.

## PART 3 EXECUTION

### 3.1 Delivery, Handling and Storage

a. Materials shall be delivered and handled in a manner to avoid bending or other damage and to avoid contact with the soil or other contaminating materials.

b. Finish of the framing members shall be maintained at all times, using an approved high zinc dust content galvanizing repair paint whenever necessary to prevent the formation of rust.

### 3.2 CONNECTIONS

#### 3.2.1 Welds

All welding shall be performed in accordance with AWS D1.3, as modified by AISI SG-671. All welders, welding operations, and welding procedures shall

be qualified according to AWS D1.3. All welds shall be cleaned and coated with rust inhibitive galvanizing paint.

### 3.2.2 Anchors

Anchors shall be of the type, size, and location shown on the drawings.

## 3.3 INSTALLATION

### 3.3.1 General Requirements

- a. Prefabricated frames shall be square, with components attached to prevent racking during fabrication, transportation, and lifting. Design and construction of frames shall include provisions for lifting.
- b. Cutting of steel framing shall be by saw, shear, or plasma cutting equipment. Oxyacetylene torch cutting is not permitted.
- c. Temporary bracing shall be provided and remain in place until work is permanently stabilized.
- d. Abutting lengths of track shall be butt-welded, spliced, or each length securely anchored to a common structural element. Track shall be securely anchored to the supporting structure as shown on the drawings.
- e. Splicing of framing components, other than track and tension members, is not permitted.
- f. Wire tying of framing members is not permitted.

### 3.3.2 Non-Load Bearing Walls (Curtain walls)

- a. Studs shall be spaced as shown on the drawings.
- b. Studs shall be plumbed, aligned, and secured to the continuous runner tracks at each end, unless the stud end terminates at a deflection track.
- c. Tracks shall be securely anchored to the supporting structure as shown on the drawings.
- d. Framed wall openings shall include headers and supporting components as shown on the drawings. Headers shall be installed in all openings that are larger than the stud spacing in a wall.
- e. At wall openings for doors, windows and other similar features, the framing system shall provide for the installation and anchorage of the required subframes or finish frames. Steel frames shall be securely attached through built-in anchors to the nearest stud on each side of the opening with self-drilling screws. Double studs shall be provided at both jambs of all door openings.
- f. Installation of sheathing, wallboards, or any other collateral material shall be performed in accordance with the product

manufacturer's specifications.

- g. Components (Deflection Track and/or Slide Clips) shall be provided at locations shown on the drawings to accommodate potential movements of Primary Frames. Construction shall accommodate a vertical movement of 25 mm.

#### 3.4 TOLERANCES

Vertical alignment (plumbness) of studs shall be within 1/960th of the span. Horizontal alignment (levelness) of walls shall be within 1/960th of their respective lengths. Spacing of studs shall not be more than plus 3 mm from the designed spacing providing the the cumulative error does not exceed the requirements of the finishing material.

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## DIVISION 05 - METALS

## SECTION 05500

## MISCELLANEOUS METAL

01/02

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-- End of Section Table of Contents --

## SECTION 05500

MISCELLANEOUS METAL  
01/02

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## ALUMINUM ASSOCIATION (AA)

AA DAF-45 (1997) Designation System for Aluminum Finishes

## AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A14.3 (1992) Ladders - Fixed - Safety Requirements

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 123/A 123M (2001) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

ASTM A 269 (2002) Seamless and Welded Austenitic Stainless Steel Tubing

ASTM A 283/A 283M (2000) Low and Intermediate Tensile Strength Carbon Steel Plates

ASTM A 36/A 36M (2000a) Carbon Structural Steel

ASTM A 307 (2002) Carbon Steel Bolts and Studs, 60000 psi Tensile Strength

ASTM A 312 (2002) Seamless and Welded Austenitic Stainless Steel Pipes

ASTM A 475 (1998) Zinc-Coated Steel Wire Strand

ASTM A 492 (2000) Stainless Wire Rope.

ASTM A 53/A 53M (2001) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

ASTM A 653/A 653M (2000) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

ASTM A 924/A 924M (1999) General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process

ASTM D 2047 (1999) Static Coefficient of Friction of Polish-Coated Floor Surfaces as Measured by the James Machine

ASTM E 814 (2000) Fire Tests of Through-Penetration Fire Stops

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M (2000) Structural Welding Code - Steel

NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS (NAAMM)

NAAMM MBG 531 (1994) Metal Bar Grating Manual

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 10 (1998; Errata 10-98-1) Portable Fire Extinguishers

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

CID A-A-344 (Rev B) Lacquer, Clear Gloss, Exterior, Interior

FEDERAL SPECIFICATIONS (FS)

FF-C-450 (1974) Clamps, Wire Rope

## 1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

### SD-02 Shop Drawings

Miscellaneous Metal Items; G, AE.

Detail drawings indicating material thickness, type, grade, and class; dimensions; and construction details. Drawings shall include catalog cuts, erection details, manufacturer's descriptive data and installation instructions, and templates. Detail drawings for the following items: For Shop Drawings of stairs, railings, and raised seating platform, provide drawings stamped by Colorado Registered Engineer.

### SD-05 Design Data

Stairs and Railings; G, AE.

Stairs shown on Architectural Drawings are conceptual. Contractor shall maintain the intent by use of the shapes shown on the Architectural Drawings and shall submit calculations stamped by a Colorado Registered Professional Engineer for the structural

design of the steel stairs before proceeding with fabrication.

Raised Seating Platform; G, AE.

Contactor shall submit calculations stamped by a Colorado Registered Professional Engineer for the structural design of the raised seating platform before proceeding with fabrication.

#### 1.2.1 Services of a Professional Engineer

The Contractor shall obtain the services of a Registered Professional engineer to design, supervise and inspect the installation of the items identified by this specification that require structural design and stamped submittals. The Registered Professional Engineer refers to a person, who, by reason of his knowledge of the physical sciences and the principles of engineering and mathematics, acquired by education and related practical experience, is qualified to engage in the practice of structural design. Stairs, railings, and raised seating platform are designed, installed, and inspected in accordance with the requirements specified.

#### 1.3 GENERAL REQUIREMENTS

The Contractor shall verify all measurements and shall take all field measurements necessary before fabrication. Welding to or on structural steel shall be in accordance with AWS D1.1/D1.1M. Items specified to be galvanized, when practicable and not indicated otherwise, shall be hot-dip galvanized after fabrication. Galvanizing shall be in accordance with ASTM A 123/A 123M, ASTM A 653/A 653M, or ASTM A 924/A 924M, as applicable. Exposed fastenings shall be compatible materials, shall generally match in color and finish, and shall harmonize with the material to which fastenings are applied. Materials and parts necessary to complete each item, even though such work is not definitely shown or specified, shall be included. Poor matching of holes for fasteners shall be cause for rejection. Fastenings shall be concealed where practicable. Thickness of metal and details of assembly and supports shall provide strength and stiffness. Joints exposed to the weather shall be formed to exclude water.

#### 1.4 DISSIMILAR MATERIALS

Where dissimilar metals are in contact, or where aluminum is in contact with concrete, mortar, masonry, wet or pressure-treated wood, or absorptive materials subject to wetting, the surfaces shall be protected with a coat of bituminous paint or asphalt varnish.

#### 1.5 WORKMANSHIP

Miscellaneous metalwork shall be well formed to shape and size, with sharp lines and angles and true curves. Drilling and punching shall produce clean true lines and surfaces. Welding shall be continuous along the entire area of contact except where tack welding is permitted. Exposed connections of work in place shall not be tack welded. Exposed welds shall be ground smooth. Exposed surfaces of work in place shall have a smooth finish, and unless otherwise approved, exposed riveting shall be flush. Where tight fits are required, joints shall be milled. Corner joints shall be coped or mitered, well formed, and in true alignment. Work shall be accurately set to established lines and elevations and securely fastened in place. Installation shall be in accordance with manufacturer's installation instructions and approved drawings, cuts, and details.

## 1.6 ANCHORAGE

Anchorage shall be provided where necessary for fastening miscellaneous metal items securely in place. Anchorage not otherwise specified or indicated shall include slotted inserts made to engage with the anchors, expansion shields, and power-driven fasteners when approved for concrete; toggle bolts and through bolts for masonry; machine and carriage bolts for steel; and lag bolts and screws for wood.

## 1.7 ALUMINUM FINISHES

Unless otherwise specified, aluminum items shall have anodized finish. The thickness of the coating shall be not less than that specified for protective and decorative type finishes for items used in interior locations or architectural Class I type finish for items used in exterior locations in AA DAF-45. Items to be anodized shall receive a polished satin finish. Aluminum surfaces to be in contact with plaster or concrete during construction shall be protected with a field coat conforming to CID A-A-344.

## 1.8 SHOP PAINTING

Surfaces of ferrous metal except galvanized surfaces, shall be cleaned and shop coated with the manufacturer's standard protective coating unless otherwise specified. Surfaces of items to be embedded in concrete shall not be painted. Items to be finish painted shall be prepared according to manufacturer's recommendations or as specified.

## 1.9 DESIGN CRITERIA FOR STEEL STAIRS & RAILINGS

General: Contractor shall verify stair and railing designs shown on Architectural Drawings Design in accordance with Uniform Building Code.

### 1.9.1 Stairs

Stair treads and landings shall be designed to support a uniform load of 4.79 kPa (100 psf) of a concentrated load of 136 kg (300 lb) on an area of 2580 sq. mm (4 sq. in.). Limit deflection treads, landings and framing members to 1/180 of span.

### 1.9.2 Guardrails

Design guardrails to withstand a concentrated load of 0.89 kn (200 lb) per lineal foot at any point or direction, or a uniform load of 0.22 kn (50 lb) per lineal foot horizontally concurrent with uniform load of 0.44 kn (100 lb) per lineal foot vertically, downward.

### 1.9.3 Raised Seating Platform

The raised seating platform shall be designed meeting all criteria outlined in ASCE 7-98 minimum Design loads for buildings and other structures and the 1997 Uniform Building Code.

## PART 2 PRODUCTS

### 2.1 ACCESS DOORS AND PANELS

Doors and panels shall be flush type except in areas with wall tile finish. Frames for access doors shall be fabricated of not lighter than 1.52 mm

(16 gauge) steel with welded joints and finished with anchorage for securing into construction. Access doors shall be a minimum of 350 by 500 mm and of not lighter than 1.9 mm (14 gauge) steel, with stiffened edges, complete with attachments. Access doors shall be hinged to frame and provided with a flush face, screw driver operated latch. Access doors in areas of tile finish shall have recessed face to receive tile finish. Exposed metal surfaces shall have a shop applied prime coat.

## 2.2 CORNER GUARDS AND SHIELDS

Corner guards and shields for jambs and sills of openings and edges of platforms shall be steel shapes and plates anchored in masonry or concrete with welded steel straps or end weld stud anchors. Corner guards on exterior shall be galvanized.

## 2.3 PIPE GUARDS AND PIPE POSTS

Pipe guards and posts shall be heavy duty steel pipe conforming to ASTM A 53/A 53M, Type E or S, weight STD, rust inhibitive primer finish.

## 2.4 FLOOR PLATES

Floor plates shall be 6 mm thick, slip-resistant, carbon steel conforming to ASTM A 283/A 283M having a minimum static coefficient of friction of 0.50 when tested in accordance with ASTM D 2047. Wearing surface shall be aluminum oxide or silicon carbide.

## 2.5 HANDRAILS AND GUARDAILS

Handrails shall be designed to resist a concentrated load of 890 N (200 pounds) in any direction at any point of the top of the rail or 292 Newtons per meter (20 pounds per foot) applied horizontally to top of the rail, whichever is more severe. Contractor shall verify design shown on Architectural Drawings prior to fabrication.

### 2.5.1 Steel Handrails, Including Carbon Steel Inserts

Interior handrails, including inserts in concrete, shall be Type 304 Stainless steel pipe conforming to ASTM A 312 or stainless steel tubing conforming to ASTM A 269. Steel railings shall be 40 mm nominal size. Infill between top rail and stair stringer shall be 6 mm diameter cable consisting of Type 304 stainless steel wire in accordance with ASTM A 492. Exterior railings shall be hot-dip galvanized pipe conforming to ASTM 53 or hot-dip galvanized tubing conforming to ASTM A 500.

#### a. Join posts, rail, and corners by one of the following methods:

(1) Flush type rail fittings of commercial standard, welded and ground smooth with railing splice locks secured with 10 mm hexagonal recessed-head setscrews.

(2) Mitered and welded joints by fitting post to top rail and intermediate rail to post, mitering corners, groove welding joints, and grinding smooth. Railing splices shall be butted and reinforced by a tight fitting interior sleeve not less than 150 mm long.

(3) Railings may be bent at corners in lieu of jointing, provided bends are made in suitable jigs and the pipe is not crushed.

- b. Provide woven mesh infill, toe-boards, and brackets as indicated.

## 2.6 CABLES

Cables for exterior barriers shall be prestretched, 6 x 19 class, I.R.W.C. galvanized wire rope of the sizes indicated. Wire rope shall conform to ASTM A 475, high strength grade with Class A coating. Cables shall have factory attached, galvanized fittings as indicated.

### 2.6.1 Wire Rope Clamps

Type I, Galvanized per FF-C-450.

### 2.6.2 U-Bolts

13 mm diameter steel bolts with hex nuts, galvanized in accordance with ASTM A 307.

## 2.7 LADDERS

Ladders shall be shop prime painted steel or mill-finish aluminum, fixed rail type in accordance with ANSI A14.3.

## 2.8 MISCELLANEOUS

Miscellaneous plates and shapes for items that do not form a part of the structural steel framework, such as lintels, sill angles, miscellaneous mountings, and frames, shall be provided to complete the work.

## 2.9 SAFETY NOSING

Safety nosings for exterior concrete stairs shall be of cast aluminum with plain, abrasive surface. Nosing shall be 75 mm wide and terminating at not more than 150 mm from the ends of treads, except nosing for metal pan cement-filled treads shall extend the full length of the tread. Safety nosings shall be provided with anchors not less than 19 mm long. Integrally cast mushroom anchors are not acceptable.

## 2.10 STEEL STAIRS

Interior steel stairs shall be complete with structural header channels, steel tube stringers, metal pan concrete-filled treads, landings, columns, stainless steel handrails, and necessary bolts and other fastenings as indicated. Concrete fill shall be site-placed. Structural steel shall conform to ASTM A 36/A 36M. Stairs and accessories shall be shop prime painted. Risers on stairs with metal pan treads shall be deformed to form a sanitary cove to retain the tread concrete. Tread pans shall be welded to stringers on upper surfaces so that concrete fill covers welds.

## 2.11 FIRE EXTINGUISHER CABINETS

Cabinets to be located in fire-rated walls shall be fire-rated type, fabricated in accordance with ASTM E 814, and shall be listed by an approved testing agency for 1- and 2-hour combustible and non-combustible wall systems. The testing agency's seal shall be affixed to each fire-rated cabinet. Cabinets shall be of the semi-recessed type suitable for 4.5 kg extinguishers. Box and trim shall be of heavy gage rolled steel. Trim shall project 2-1/2 inches maximum, with rolled edges. Door



shall be a rigid frame with full length piano type hinge and double strength (DSA) glass panel. Door and panel shall be prime-coated inside and out.

## 2.12 FLOOR GRATINGS AND FRAMES

Carbon steel grating shall be designed in accordance with NAAMM MBG 531 to meet the indicated load requirements. Edges shall be banded with bars 6 mm less in height than bearing bars for grating sizes above 19 mm. Banding bars shall be flush with the top of bearing grating. Frames shall be of welded steel construction finished to match the grating. Floor gratings and frames shall be galvanized after fabrication.

## PART 3 EXECUTION

### 3.1 GENERAL INSTALLATION REQUIREMENTS

All items shall be installed at the locations shown and according to the manufacturer's recommendations. Items listed below require additional procedures as specified.

### 3.2 REMOVABLE ACCESS PANELS

A removable access panel not less than 300 by 300 mm shall be installed directly below each valve, flow indicator, damper, or air splitter that is located above the ceiling, other than an acoustical ceiling, and that would otherwise not be accessible.

### 3.3 INSTALLATION OF PIPE GUARDS

Pipe guards shall be set vertically in concrete piers. Piers shall be constructed of, and the hollow cores of the pipe filled with, concrete specified in Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE.

### 3.4 ATTACHMENT OF HANDRAILS

Toeboards and brackets shall be installed where indicated. Splices, where required, shall be made at expansion joints. Removable sections shall be installed as indicated.

#### 3.4.1 Installation of Exterior Steel Handrails

Installation shall be in pipe sleeves embedded in concrete and filled with molten lead or sulphur with anchorage covered with standard pipe collar pinned to post or by means of pipe sleeves secured to base plates bolted to stringers or structural steel framework. Rail ends shall be secured by steel pipe flanges anchored by expansion shields and bolts. Through-bolted to a back plate or by 6 mm lag bolts to studs or solid backing.

#### 3.4.2 Installation of Steel Handrails Along Walls

Railings shall be secured to walls on brackets. Brackets shall be fastened to studs or blocking with 6 mm lag bolts. Rail ends shall curve back to terminate at the face of wall finish.

### 3.5 INSTALLATION OF SAFETY NOSINGS

Nosing shall be completely embedded in concrete before the initial set of the concrete occurs and shall finish flush with the top of the concrete

surface.

### 3.6 INSTALLATION OF FIRE EXTINGUISHER CABINETS

Metal fire extinguisher cabinets shall be furnished and installed in accordance with NFPA 10 where shown on the drawings or specified.

### 3.7 INSTALLATION OF FLOOR GRATINGS

Attach grates with non-removable, corrosion-resistant fasteners to galvanized steel frames, cast into concrete.

-- End of Section --

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## DIVISION 05 - METALS

## SECTION 05520

## GLAZED GUARD RAILS

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## SECTION 05520

## GLAZED GUARD RAILS

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM B 221	(1992) Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes
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## 1.2 GENERAL REQUIREMENTS

Definitions in ASTM E 985 for railing-related terms apply to this section. Obtain railing systems from a single manufacturer. Engage a qualified professional engineer to prepare or supervise the preparation of structural computations for railing systems to determine compliance with structural performance requirements indicated. Engage a professional engineer who is licensed to practice in jurisdiction where Project is located and who is experienced in providing structural engineering services of the kind required for work of this section.

## 1.3 SYSTEM PERFORMANCE

Structural performance of Handrails and Railing Systems: Design, engineer, fabricate, and install handrails and railing systems to withstand the following structural loads without exceeding the allowable design working stress of the materials for handrails, railing systems, anchors, and connections. Apply each load to produce the maximum stress in each of the respective components comprising handrails and railing systems.

## 1.3.1 Rail Systems capable of withstanding the following loads applied as indicated.

- a. Uniform load of 730 N/M (50 lb/ft) applied horizontally at the top of the guard.
- b. Uniform load of 1.2 kN/sq.m (25 psf) applied horizontally to the infill area of the Guard (concurrent with load in (a.) above).

## 1.3.2 Thermal Design:

Design provisions shall be made to allow for thermal expansion and contraction in order to prevent stress cracking of glass panels.

#### 1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

##### SD-03 Product Data;

Manufacturer's Data; G-AE

Manufacturer's technical data for products and processes used in handrails and railing systems, including finishes and glass.

##### SD-02 Shop Drawings;

Fabrication and Installation Drawings; G-AE

Show details of fabrication and installation for each type and material railing system required including plans, elevations, sections, profiles of rails, fittings, connections, and anchors. Drawings shall be sealed by a Registered Engineer.

##### SD-06 Test Reports.

Test reports from independent testing laboratory evidencing compliance of handrails and railing systems with ASTM E 985. Include structural computations evidencing compliance of handrails and railing systems with design loadings indicated.

#### 1.5 STORAGE

Store handrails and railing systems in clean, dry location, away from uncured concrete and masonry, protected against damage of any kind. Cover with water proof paper, tarpaulin, or polyethylene sheeting; allow for air circulation inside the covering.

### PART 2 PRODUCTS

#### 2.1 MANUFACTURERS

Subject to compliance with design requirements, provide handrails and railing systems of one of the following or approved equal.

- a. ACI Glass Products.
- b. Architectural Art Mfg., Inc.
- c. Blumcraft of Pittsburgh.
- d. Lavi Industries.
- e. Livers Bronze Co.
- f. Newman Bros., Inc.
- g. Poma Corp.

#### 2.2 SYSTEM DESCRIPTION

Guard system consisting of horizontal, metal top rail, vertical, glass infill panels and bottom shoe moldings with glazing and fastening accessories, complete to provide engineered system.

## 2.3 MATERIALS

### 2.3.1 Top Rail

ASTM B , Type 302 or 304 roll-formed stainless steel tube shape, and formed with glazing receiver channel. Finish: 4 , Size: 3-inch diameter.

### 2.3.2 Glass Infill Panels

1/2-inch thickness, fully tempered clear glass, ASTM C 1048 Kind FT C condition A, Type I, Glazing Select, edges rounded and ends finished smooth. Comply with ANSI Z97.1 and CFR 16 part 1201.

### 2.3.3 Bottom Shoe Molding

ASTM B 221, Alloy 6063, Temper T-52, extruded aluminum molding, formed to channel shape to receive glass and glazing. Finish: stainless steel covering, finish 4. Size 4 1/4-inch high x 2 1/2-inch width, metal thickness approximately 3/4-inch, with provisions for fasteners to structural steel base.

### 2.3.4 Glazing

PVC setting blocks, inserts, and fillers to mount glass infill panels into shoe moldings and top rails.

### 2.3.5 Mounting Bolts

1/2-inch Stainless steel fasteners at 12-inch maximum spacing.

### 2.3.6 Toprail end Caps

Anodized aluminum to match rail size and finish.

## 2.4 FABRICATION

### 2.4.1 General

Fabricate handrails and railings to design, dimensions and details indicated.

### 2.4.2 Shop Assembly

Preassemble items in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

### 2.4.3 Glass Panels

Provide for proper edge clearance and bite on glass. Provide thickness indicated or, if not otherwise indicated, thickness recommended by manufacturer for size and loading conditions indicated.

### 2.4.4 Anchorage Devices

Furnish inserts and other anchorage devices for connecting handrails and railing systems to building structure and laminated glass to railings.

Fabricate anchorage devices which are capable of withstanding loadings imposed by handrails and railing systems. Coordinate anchorage devices with supporting structure.

### PART 3 EXECUTION

#### 3.1 PREPARATION

Coordinate setting drawings, diagrams, templates, instructions, and directions for installation of anchorages, such as sleeves, inserts, anchor bolts and miscellaneous items. Coordinate delivery of such items to project site. Take field measurements prior to fabrication.

#### 3.2 INSTALLATION

##### 3.2.1 General

Perform cutting, drilling and fitting required for installation of handrails and railings. Set work accurately in location, alignment and elevation, plumb, level, true and free of rack, measured from established lines and levels. Do not weld, cut or abrade surfaces of handrail or railing components which have been finished after fabrication, and are intended for field connection by mechanical means without further cutting or fitting.

##### 3.2.2 Glass Panels

Install assembly to comply with railing manufacturer's instructions.

##### 3.2.3 Protection

Protect finishes of railing systems and handrails from damage during construction period by use of temporary protective covering approved by railing manufacturer. Remove protective covering at time of Substantial Completion. Restore Finishes damaged during installation and construction period so that no evidence remains of correction work. Return items which cannot be refinished in the field to the shop; make required alterations and refinish entire unit, or provide new units as required.

-- End of Section --

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## DIVISION 05 - METALS

## SECTION 05811

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-- End of Section Table of Contents --

## SECTION 05811

## ARCHITECTURAL JOINT SYSTEMS

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM B 209	(2000) Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B 221	(2000) Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles and Tubes
ASTM D 2000	(2001) Classification System for Rubber Products in Automotive Applications

## 1.2 DEFINITIONS

## 1.2.1 Architectural Joint System

Any filler or cover used to span, fill, cover, or seal a joint, except expanding foam seals and poured or foamed in-place sealants.

## 1.2.2 Cyclic Movement

Periodic change between widest and narrowest joint widths in an automatically mechanically controlled system.

## 1.2.3 Fire Barriers

Any material or material combination, when fire tested after cycling, designated to resist passage of flame and hot gases through a movement joint.

## 1.2.4 Maximum Joint Width

Widest linear gap a joint system tolerates and performs its designed function without damaging its functional capabilities.

## 1.2.5 Minimum Joint Width

Narrowest linear gap a joint system tolerates and performs its designed function without damaging its functional capabilities.

## 1.2.6 Movement Capability

Value obtained from the difference between widest and narrowest widths of a joint opening typically expressed in numerical values (mm or inches) or a

percentage of nominal value of joint width.

#### 1.2.7 Nominal Joint Width

Width of linear gap indicated as representing the conditions existing when architectural joint systems will be installed or, if no nominal joint width is indicated, a width equal to the sum of maximum and minimum joint widths divided by two.

### 1.3 PERFORMANCE REQUIREMENTS

#### 1.3.1 General

Provide factory-fabricated architectural joint systems capable of withstanding the types of loads and of accommodating the kinds of movement, and the other functions for which they are designed including those specified below, without failure. Types of failure include those listed in Appendix X3 of ASTM E 1399.

1. Pedestrian Traffic Joints: Support pedestrian traffic across joint.
2. Exterior Joints: Maintain continuity of weather enclosure.
3. Joints in Smoke Barriers: Maintain integrity of smoke barrier.
4. Joints in Acoustically Rated Assemblies: Inhibit passage of airborne noise.
5. Other Joints: Where indicated, provide joint systems that prevent penetration of water, moisture, and other substances deleterious to building components or content.
6. Seismic Joints: Remain in place on exposure to seismic activity (movement).
7. Joints in Surfaces with Architectural Finishes: Serve as finished architectural joint closures.

#### 1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

##### SD-02 Shop Drawings

Placement Drawings; G, AE.

Include line diagrams showing entire route of each joint system, plans, elevations, sections, details, joints, splices, locations of joints and splices, and attachments to other Work. Where joint systems change planes, provide Isometric Drawings depicting how components interconnect to achieve continuity of joint covers and fillers.

##### SD-03 Product Data

Product Data; G, AE.

Include manufacturer's product specifications, construction details, material and finish descriptions, and dimensions of individual components and seals.

## SD-04 Samples

Samples for Initial Selection; G, AE.

Manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available for each exposed metal and elastomeric material of joint system indicated.

1. Include similar Samples of material for joints and accessories involving color selection.

## SD-06 Test Reports

Product Test Report; G, AE.

From a qualified testing agency indicating architectural joint systems comply with requirements, based on comprehensive testing of current products.

## 1.5 QUALITY ASSURANCE

## 1.5.1 Source Limitations

Obtain architectural joint systems through one source from a single manufacturer for each type of joint. Coordinate compatibility with adjoining joint systems specified in other Sections.

## 1.5.2 Product Options

Drawings indicate size, profiles, and dimensional requirements of architectural joint systems and are based on the specific systems indicated. Other manufacturers' systems complying with requirements may be considered. Refer to Division 1 Section "Product Requirements."

1. Do not modify intended aesthetic effects, except with Contracting Officer's approval. If modifications are proposed, submit comprehensive explanatory data to Contracting Officer for review.

## PART 2 PRODUCTS

## 2.1 MANUFACTURERS

## 2.1.1 Basis-of-Design Products

The design for each architectural joint system specified in Part 2 "Architectural Joint Systems" Article below is based on the products named. A product manufactured by any manufacturer meeting the requirements specified may be used.

## 2.2 MATERIALS

## 2.2.1 Aluminum

ASTM B 221 (ASTM B 221M), alloy 6063-T5 for extrusions; ASTM B 209 (ASTM B 209M), alloy 6061-T6 for sheet and plate.

1. Apply manufacturer's standard protective coating on aluminum

surfaces to be placed in contact with cementitious materials.

#### 2.2.2 Preformed Seals

Single or multicellular extruded elastomeric seals designed with or without continuous, longitudinal, internal baffles. Formed to be installed in frames or with anchored flanges, in color indicated or, if not indicated, as selected by Contracting Officer from manufacturer's standard colors.

#### 2.2.3 Strip Seals

Elastomeric membrane or tubular extrusions with a continuous longitudinal internal baffle system throughout complying with ASTM E 1783; used with compatible frames, flanges, and molded-rubber anchor blocks.

#### 2.2.4 Compression Seals

Preformed, elastomeric extrusions having internal baffle system complying with ASTM E 1612 in sizes and profiles indicated or as recommended by manufacturer.

#### 2.2.5 Accessories

Manufacturer's standard anchors, clips, fasteners, set screws, spacers, flexible moisture barrier and filler materials, drain tubes, lubricants, adhesives, and other accessories compatible with material in contact, as indicated or required for complete installations.

### 2.3 ARCHITECTURAL JOINT SYSTEMS

#### 2.3.1 General

Provide joint systems of design, basic profile, materials, and operation indicated. Provide units with the capability to accommodate joint widths indicated and variations in adjacent surfaces.

1. Furnish units in longest practicable lengths to minimize number of end joints. Provide hairline mitered corners where joint changes directions or abuts other materials.
2. Include closure materials and transition pieces, tee-joints, corners, curbs, cross-connections, and other accessories as required to provide continuous joint systems.
3. Frames for Strip Seals: Designed with semiclosed cavity that provides a mechanical lock for seals of type indicated.

#### 2.3.2 Floor Joint System

Metal frames and covers for interior pedestrian traffic joints.

1. Basis-of-Design Product: C-S Group HFX series.
2. Maximum Joint Width: 25 to 51 mm (1- to 2 inches).
3. Nominal Joint Width: 13 to 25 mm (1/2 to 1 inch).
4. Minimum Joint Width: 6 to 13 mm (1/4 to 1/2 inch).
5. Movement Capability: 45 mm (1-3/4 inches).
6. Type of Movement Capability: Expansion and contraction.
7. Cyclic-Movement-Test-Response Characteristics: No evidence of visual fatigue, inability to cycle between designated joint widths, or other types of failure as determined by testing products identical to those indicated per ASTM E 1399 including Appendix X3.

8. Exposed Cover Material: Aluminum, clear anodized finish.
9. Exposed Frame Material: Same material and finish as exposed cover material.

### 2.3.3 Wall Joint System

Metal frames and covers for exterior joints between curtain wall framing and metal wall paneling.

1. Basis-of-Design Product: C-S Group, SF 200.
2. Maximum Joint Width: 50 mm (2 inches).
3. Nominal Joint Width: 25 mm (1 inch).
4. Minimum Joint Width: 12 mm (1/2 inch).
5. Movement Capability: 38 mm (1-1/2 inches).
6. Type of Movement Capability: Expansion and contraction.
7. Cyclic-Movement-Test-Response Characteristics: No evidence of visual fatigue, inability to cycle between designated joint widths, or other types of failure as determined by testing products identical to those indicated per ASTM E 1399 including Appendix X3.
8. Exposed Cover Material: Aluminum, clear anodized finished to match curtain wall framing or metal wall panels.
9. Exposed Frame Material: Same material and finish as exposed cover material.
10. Moisture Barrier: Provide manufacturer's standard primary and secondary extruded PVC.

### 2.3.4 Wall-to-Roof Joint System

Metal frames and preformed seals for exterior joints.

1. Basis-of-Design Product: C-S Group, BRJ Series.
2. Maximum Joint Width: 50 mm (2 inches).
3. Nominal Joint Width: 25 mm (1 inch).
4. Minimum Joint Width: 12 mm (1/2 inch).
5. Movement Capability: 38 mm (1-1/2 inches).
6. Type of Movement Capability: Expansion and contraction.
7. Cyclic-Movement-Test-Response Characteristics: No evidence of visual fatigue, inability to cycle between designated joint widths, or other types of failure as determined by testing products identical to those indicated per ASTM E 1399 including Appendix X3.
8. Preformed Seal Material: Manufacturer's standard neoprene bellow with extruded PVC secondary seal, complying with ASTM D 2000.
  - a. Seal Color: Color as Selected by Contracting Officer.
9. Exposed Frame Material: Aluminum, mill finish.
10. Moisture Barrier: Provide manufacturer's standard unit.

### 2.4 FINISHES, GENERAL

Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

### 2.5 ALUMINUM FINISHES

Finish designations prefixed by AA comply with the system established by

the Aluminum Association AA 501 for designating aluminum finishes.

#### 2.5.1 Mill Finish

AA-M10 (Mechanical Finish: as fabricated; no other applied finish unless buffing is required to remove scratches, welding, or grinding produced in fabrication process.

#### 2.5.2 Class I, Clear Anodic Finish

AA-M12C22A41 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 607.1.

### PART 3 EXECUTION

#### 3.1 PREPARATION

##### 3.1.1 Prepare Substrates

Prepare substrates according to architectural joint system manufacturer's written instructions.

##### 3.1.2 Coordination

Coordinate and furnish anchorages, Placement Drawings, and instructions for installing joint systems to be embedded in or anchored to concrete or to have recesses formed into edges of concrete slab for later placement and grouting-in of frames.

##### 3.1.3 Fasteners

Provide anchorage devices and fasteners where necessary to secure joint systems to in-place construction, including threaded fasteners with drilled-in expansion shields for masonry and concrete where anchoring members are not embedded in concrete. Provide fasteners of metal, type, and size to suit type of construction indicated and to provide for secure attachment of joint systems.

#### 3.2 INSTALLATION

##### 3.2.1 General

Comply with manufacturer's written instructions for handling and installing architectural joint assemblies and materials, unless more stringent requirements are indicated.

##### 3.2.2 Coordination

Coordinate installation of architectural joint assembly materials and associated work so complete assemblies comply with assembly performance requirements.

##### 3.2.3 Termination

Terminate exposed ends of exterior architectural joint assemblies with factory-fabricated termination devices to maintain waterproof system.

##### 3.2.4 Transitions



Install factory-fabricated transitions between building expansion-joint cover assemblies and roof expansion-joint assemblies, specified in Division 7 Section "Roof Expansion Assemblies," to provide continuous, uninterrupted, watertight construction.

### 3.2.5 Cutting, Fitting, and Placement

Perform cutting, drilling, and fitting required to install joint systems.

1. Install joint cover assemblies in true alignment and proper relationship to joints and adjoining finished surfaces measured from established lines and levels.
2. Allow adequate free movement for thermal expansion and contraction of metal to avoid buckling.
3. Set covers in horizontal surfaces at elevations that place exposed surfaces flush with adjoining finishes.
4. Locate wall covers in continuous contact with adjacent surfaces.
5. Securely attach in place with required accessories.
6. Locate anchors at interval recommended by manufacturer, but not less than 3 inches (75 mm) from each end and not more than 24 inches (600 mm) o.c.

### 3.2.6 Continuity

Maintain continuity of joint systems with a minimum number of end joints and align metal members. Cut and fit ends to produce joints that will accommodate thermal expansion and contraction of metal to avoid buckling of frames. Adhere flexible filler materials, if any, to frames with adhesive or pressure-sensitive tape as recommended by manufacturer.

### 3.2.7 Extruded Preformed Seals

Install seals to comply with manufacturer's written instructions and with minimum number of end joints.

1. For straight sections, provide preformed seals in continuous lengths.
2. Vulcanize or heat-weld field splice joints in preformed seal material to provide watertight joints using procedures recommended by manufacturer.
3. Apply adhesive, epoxy, or lubricant adhesive approved by manufacturer to both frame interfaces before installing preformed seals.
4. Seal transitions according to manufacturer's written instructions.
5. Install foam seals with adhesive recommended by manufacturer and heat seal all splices.

### 3.2.8 Joint Systems with Seals

Seal end joints within continuous runs and joints at transitions according to manufacturer's written instructions to provide a watertight installation.

## 3.3 CLEANING AND PROTECTION

Do not remove protective covering until finish work in adjacent areas is complete. When protective covering is removed, clean exposed metal surfaces to comply with manufacturer's written instructions.

-- End of Section --



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## DIVISION 06 - WOODS &amp; PLASTICS

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**02/02**

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## SECTION 06100

## ROUGH CARPENTRY

**02/02**

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN FOREST &amp; PAPER ASSOCIATION (AF&amp;PA)

AF&PA T101 (1991; Supple 1993; Addenda Apr 1997; Supple T02) National Design Specification for Wood Construction

AF&PA T11 (1988) Manual for Wood Frame Construction  
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## AMERICAN INSTITUTE OF TIMBER CONSTRUCTION (AITC)

AITC 111 (1979) Recommended Practice for Protection of Structural Glued Laminated Timber During Transit, Storage and Erection

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 1177/C 1177M (1999) Glass Mat Gypsum Substrate for Use as Sheathing

ASTM C 518 (1998) Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus

ASTM C 578 (1995) Rigid, Cellular Polystyrene Thermal Insulation

ASTM C 665 (1998) Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing

ASTM C 79/C 79M (2000) Treated Core and Nontreated Core Gypsum Sheathing Board

ASTM E 154 (1988; R 1999) Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover

ASTM E 84 (2000a) Surface Burning Characteristics of Building Materials

ASTM F 547 (1977; R 1995) Definitions of Terms Relating to Nails for Use with Wood and

## Wood-Based Materials

## AMERICAN WOOD-PRESERVERS' ASSOCIATION (AWPA)

AWPA C2	(2000) Lumber, Timber, Bridge Ties and Mine Ties - Preservative Treatment by Pressure Processes
AWPA C20	(1999) Structural Lumber Fire-Retardant Pressure Treatment
AWPA C27	(1999) Plywood - Fire-Retardant Pressure Treatment
AWPA C9	(1997) Plywood - Preservative Treatment by Pressure Processes
AWPA M4	(1999) Standard for the Care of Preservative-Treated Wood Products
AWPA P5	(2000) Standards for Waterborne Preservatives

## APA - THE ENGINEERED WOOD ASSOCIATION (APA)

APA EWS R540C	(1996) Builder Tips Proper Storage and Handling of Glulam Beams
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## FACTORY MUTUAL ENGINEERING AND RESEARCH (FM)

FM LPDS 1-49	(1995) Loss Prevention Data Sheet - Perimeter Flashing
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## U.S. DEPARTMENT OF COMMERCE (DOC)

PS1	(1995) Construction and Industrial Plywood
PS2	(1993) Wood-Base Structural-Use Panels

## 1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

## SD-07 Certificates

## Grading and Marking.

Manufacturer's certificates (approved by an American Lumber Standards approved agency) attesting that lumber and material not normally grade marked meet the specified requirements. Certificate of Inspection for grade marked material by an American Lumber Standards Committee (ALSC) recognized inspection agency prior to shipment.

Insulation; G, DO.

Certificate attesting that the glass fiber, polyurethane, or polyisocyanurate insulation furnished for the project contains recovered material, and showing an estimated percent of such recovered material.

### 1.3 DELIVERY AND STORAGE

Materials shall be delivered to the site in undamaged condition, stored off ground in fully covered, well ventilated areas, and protected from extreme changes in temperature and humidity. Laminated timber shall be handled and stored in accordance with AITC 111 or APA EWS R540C.

## PART 2 PRODUCTS

### 2.1 LUMBER AND SHEATHING

#### 2.1.1 Grading and Marking

##### 2.1.1.1 Lumber Products

Solid sawn and finger-jointed lumber shall bear an authorized gradestamp or grademark recognized by ALSC, or an ALSC recognized certification stamp, mark, or hammerbrand.

##### 2.1.1.2 Plywood and Other Sheathing Products

Materials shall bear the grademark or other identifying marks indicating grades of material and rules or standards under which produced, including requirements for qualifications and authority of the inspection organization. Except for plywood and wood structural panels, bundle marking will be permitted in lieu of marking each individual piece. Surfaces that are to be exposed to view shall not bear grademarks or other types of identifying marks.

#### 2.1.2 Sizes

Lumber and material sizes shall conform to requirements of the rules or standards under which produced. Unless otherwise specified, lumber shall be surfaced on four sides. Unless otherwise specified, sizes indicated are nominal sizes, and actual sizes shall be within manufacturing tolerances allowed by the standard under which the product is produced.

#### 2.1.3 Preservative Treatment

Exposed areas of treated wood that are cut or drilled after treatment shall receive a field treatment in accordance with AWPA M4. Except as specified for all-heart material of the previously mentioned species, the following items shall be treated:

- a. Wood members in contact with or within 455 mm of soil.
- b. Wood members exposed to the weather and those used in roofing systems or as nailing strips or nailers over gypsum-board wall sheathing.
- c. Wood members set into concrete regardless of location, including flush-with-deck wood nailers for roofs.
- d. Wood members in contact with concrete that is in contact with soil

or water or that is exposed to weather.

#### 2.1.3.1 Lumber and Timbers

Lumber and timbers shall be treated in accordance with AWPA C2 with waterborne preservatives listed in AWPA P5 to a retention level as follows:

- a. 4 kg per cubic meter (0.25 pcf) intended for above ground use.
- b. 6.4 kg per cubic meter (0.40 pcf) intended for ground contact and fresh water use.

#### 2.1.3.2 Plywood

Plywood shall be treated in accordance with AWPA C9 with waterborne preservatives listed in AWPA P5 to a retention level as follows:

- a. 4 kg per cubic meter (0.25 pcf) intended for above ground use.
- b. 6.4 kg per cubic meter (0.40 pcf) intended for ground contact and fresh water use.

#### 2.1.4 Moisture Content

At the time lumber and other materials are delivered and when installed in the work their moisture content shall be as follows:

- a. Treated and Untreated Lumber: 100 mm or less, nominal thickness, 19 percent maximum. 125 mm or more, nominal thickness, 23 percent maximum in a 75 mm perimeter of the timber cross-section.
- b. Materials Other Than Lumber: In accordance with standard under which product is produced.

#### 2.1.5 Fire-Retardant Treatment

Fire-retardant treated wood shall be pressure treated in accordance with AWPA C20 for lumber and AWPA C27 for plywood. Material use shall be defined in AWPA C20 and AWPA C27 for Interior Type A and Exterior Type. Treatment and performance inspection shall be by an independent and qualified testing agency that establishes performance ratings. Each piece or bundle of treated material shall bear identification of the testing agency to indicate performance in accordance with such rating. Treated materials to be exposed to rain wetting shall be subjected to an accelerated weathering technique in accordance with ASTM D 2898 prior to being tested for compliance with AWPA C20 or AWPA C27. Items to be treated include: Nailers and blocking for roofing, backboards for communications, sheathing in parapets.

#### 2.1.6 Sheathing

Sheathing shall be gypsum board, or plywood.

##### 2.1.6.1 Gypsum Sheathing Board

Glass mat gypsum sheathing shall conform to ASTM C 79/C 79M and ASTM C 1177/C 1177M 13 mm thick (1/2 inch thick), 1200 mm wide with straight edges for supports 400 mm on center without corner bracing or framing or for supports 600 mm on center with corner bracing or framing; 600 mm wide with



V-tongue and groove edges for supports 400 or 600 mm on center with corner bracing of framing.

#### 2.1.6.2 Plywood

Plywood shall conform to PS1, APA E445R or PS2, Grade C-D or sheathing grade with exterior glue. Sheathing for roof and walls without corner bracing of framing shall have a span rating of 16/0 or greater for supports 400 mm on center and a span rating of 24/0 or greater for supports 600 mm on center.

#### 2.1.7 Miscellaneous Wood Members

##### 2.1.7.1 Nonstress Graded Members

Members shall include grounds, and nailing strips. Members shall be in accordance with TABLE I for the species used. Sizes shall be as follows unless otherwise shown:

Member	Size mm (inch)
Grounds	Plaster thickness by 38.
Nailing strips	25 x 75 (1 x 3) or 25 x 100 (1 x 4) when used for interior finish, otherwise 50 mm (2 inch) stock.

##### 2.1.7.2 Blocking

Blocking shall be standard or number 2 grade.

#### 2.2 ACCESSORIES AND NAILS

Markings shall identify both the strength grade and the manufacturer. Accessories and nails shall conform to the following:

##### 2.2.1 Anchor Bolts

ASTM A 307, size as indicated, galvanized complete with nuts and washers.

##### 2.2.2 Bolts: Lag, Toggle, and Miscellaneous Bolts and Screws

Type, size, and finish best suited for intended use. Finish options include zinc compounds, cadmium, and aluminum paint impregnated finishes.

##### 2.2.3 Clip Angles

Steel, 5 mm (3/16 inch) thick, size best suited for intended use; or zinc-coated steel or iron commercial clips designed for connecting wood members.

##### 2.2.4 Expansion Shields

Type and size best suited for intended use.

##### 2.2.5 Nails and Staples

ASTM F 547, size and type best suited for purpose; staples shall be as recommended by the manufacturer of the materials to be joined. For sheathing length of nails shall be sufficient to extend 25 mm into supports. In general, 8-penny or larger nails shall be used for nailing through 25 mm thick lumber and for toe nailing 50 mm thick lumber; 16-penny or larger nails shall be used for nailing through 50 mm thick lumber. Nails used with treated lumber and sheathing shall be galvanized. Nailing shall be in accordance with the recommended nailing schedule contained in AF&PA T11. Where detailed nailing requirements are not specified, nail size and spacing shall be sufficient to develop an adequate strength for the connection. The connection's strength shall be verified against the nail capacity tables in AF&PA T101. Reasonable judgement backed by experience shall ensure that the designed connection will not cause the wood to split. If a load situation exceeds a reasonable limit for nails, a specialized connector shall be used.

## 2.3 INSULATION

Thermal resistance of insulation shall be not less than the R-values shown.

R-values shall be determined at 24 degrees C in accordance with ASTM C 518.

Contractor shall comply with EPA requirements in conformance with Section 01670 RECYCLED / RECOVERED MATERIALS. Insulation shall be the standard product of a manufacturer and factory marked or identified with manufacturer's name or trademark and R-value. Identification shall be on individual pieces or individual packages. Materials containing more than one percent asbestos will not be allowed.

### 2.3.1 Batt or Blanket

#### 2.3.1.1 Glass Fiber Batts and Rolls

Glass fiber batts and rolls shall conform to ASTM C 665, Type III foil faced insulation, Class A, having a UL rating of 25 and a smoke developed rating of 150 or less when tested in accordance with ASTM E 84.

### 2.3.2 Rigid Insulation

#### 2.3.2.1 Polystyrene Board

Polystyrene board shall be extruded and conform to ASTM C 578, Type IV.

#### 2.3.2.2 Polyurethane or Polyisocyanurate Board

Polyurethane or polyisocyanurate board shall have a minimum recovered material content of 9 percent by weight of core material in the polyurethane or polyisocyanurate portion. Faced polyisocyanurate shall conform to ASTM C 1289.

## 2.4 VAPOR RETARDER

Vapor retarder shall be polyethylene sheeting conforming to ASTM E 154 or other equivalent material. Vapor retarder shall have a maximum vapor permeance rating of 29 ng per Pa per second per square meter (0.5 perms) as determined in accordance with ASTM E 96, unless otherwise specified.

## PART 3 EXECUTION

### 3.1 INSTALLATION OF SHEATHING

### 3.1.1 Gypsum Board

Sheathing shall be applied with edges in light contact at joints and screw fastened in accordance with the manufacturer's approved instructions. Sheets 600 mm wide shall be applied horizontally with tongued edge up, with vertical joints over supports, and with vertical joints staggered. Sheets 1200 mm wide shall be applied vertically, extended over top and bottom plates, and with all vertical and horizontal joints over supports.

### 3.1.2 Plywood Panels

Sheathing shall be applied with edges 3 mm apart at side and end joints, and screw fastened at supported edges at 150 mm on center and at intermediate supports 300 mm on center unless otherwise shown. Fastening of edges shall be 10 mm from the edges. Wall sheathing shall extend over top and bottom plates, and if applied horizontally the vertical joints shall be made over supports and staggered.

## 3.2 INSTALLATION OF MISCELLANEOUS WOOD MEMBERS

### 3.2.1 Blocking

Blocking shall be provided as necessary for application of sheathing, and other materials or building items and to provide firestopping. Blocking for firestopping shall ensure a maximum dimension of 2400 mm for any concealed space. Blocking shall be cut to fit between framing members and rigidly nailed thereto.

### 3.2.2 Nailers and Nailing Strips

Nailers and nailing strips shall be provided as necessary for the attachment of finish materials. Nailers used in conjunction with roof deck installation shall be installed flush with the roof deck system. Stacked nailers shall be assembled with spikes or nails spaced not more than 450 mm on center and staggered. Beginning and ending nails shall not be more than 150 mm for nailer end. Ends of stacked nailers shall be offset approximately 300 mm in long runs and alternated at corners. Anchors shall extend through the entire thickness of the nailer. Strips shall be run in lengths as long as practicable, butt jointed, and rigidly secured in place. Nailers and nailer installation for Factory Mutual wind uplift rated roof systems specified in other Sections of these specifications shall conform to the recommendations contained in FM LPDS 1-49.

### 3.2.3 Wood Grounds

Wood grounds shall be provided as necessary for attachment of trim, finish, and other work to plaster. Grounds shall be run in lengths as long as practicable, butt jointed, and rigidly secured in place.

## 3.3 INSTALLATION OF INSULATION

Insulation shall be installed after construction has advanced to a point that the installed insulation will not be damaged by remaining work. For thermal insulation the actual installed thickness shall provide the thermal resistance shown. For acoustical insulation the installed thickness shall be as shown. Insulation shall be installed on the weather side of such items as electrical boxes and water lines. Unless otherwise specified, installation shall be in accordance with the manufacturer's recommendation.

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## SECTION 06200

## FINISH CARPENTRY

11/01

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM E 84	(2000a) Surface Burning Characteristics of Building Materials
ASTM F 547	(1977; R 1995) Definitions of Terms Relating to Nails for Use with Wood and Wood-Based Materials

## 1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

## SD-02 Shop Drawings

Finish Carpentry; G, AE

Drawings showing fabricated items and special mill and woodwork items. Drawings shall indicate materials and details of construction, methods of fastening, erection, and installation.

## SD-03 Product Data

Wood Items, Siding, and Trim.

Manufacturer's printed data indicating the usage of engineered or recycled wood products, and environmentally safe preservatives.

## SD-04 Samples

Moldings; G, AE.

Samples shall be of sufficient size to show patterns, color ranges, and types, as applicable, of the material proposed to be used.

## 1.3 DELIVERY AND STORAGE

Materials shall be delivered to the site in undamaged condition, stored off

ground in fully covered, well-ventilated areas, and protected from extreme changes in temperature and humidity.

## PART 2 PRODUCTS

### 2.1 WOOD ITEMS, SIDING, AND TRIM

The Contractor shall furnish products which optimize design by reducing the amount of wood used (engineered wood), by using recycled wood products and preservatives without arsenic or chromium when the products and methods are competitive in price or directed by the Contracting Officer. The Contractor shall comply with EPA requirements in accordance with Section 01670 RECYCLED / RECOVERED MATERIALS.

#### 2.1.1 Grading and Marking

Materials shall bear the grademark, stamp or other identifying marks indicating grades of material and rules or standards under which produced. Such identifying marks on a material shall be in accordance with the rule or standard under which the material is produced, including requirements for qualifications and authority of the inspection organization, usage of authorized identification, and information included in the identification. The inspection agency for lumber shall be certified by the Board of Review, American Lumber Standards Committee, to grade the species used. Except for plywood, wood structural panels, and lumber, bundle marking will be permitted in lieu of marking each individual piece. Surfaces that are to be architecturally exposed to view shall not bear grademarks, stamps, or other types of identifying marks.

#### 2.1.2 Sizes and Patterns

Lumber sizes and patterns shall conform to rules or standards under which produced. Unless otherwise specified, lumber shall be surfaced on four sides. Sizes and patterns for materials other than lumber shall conform to requirements of the rules or standards under which produced. Size references, unless otherwise specified, are nominal sizes, and actual sizes shall be within manufacturing tolerances allowed by the standard under which the product is produced.

#### 2.1.3 Moisture Content

The maximum moisture content of untreated trim and wood siding shall be 15 percent at the time of delivery to the jobsite and when installed. Moisture content of all other material shall be in accordance with the standard under which the product is produced.

#### 2.1.4 Fascias and Trim

##### 2.1.4.1 Wood

Fascias and trim, including exterior door and window casing, shall be species and grade listed in TABLE I at the end of this section. Sizes shall be as indicated. Metal corners may be furnished in lieu of wood cornerboards for horizontal siding; and if furnished, shall be galvanized steel and primed or aluminum and primed.

#### 2.1.5 Moldings

Moldings shall be of the pattern indicated and shall be of a grade

compatible with the finish specified.

#### 2.1.6 Fiber Reinforced Panels (FRP-1)

Panels are to be composed of a resin mix of modified polyester, fillers, and pigments with a random chapped fiberglass reinforcement and shall conform to ASTM E 84. With and length to be shown on the Drawings.

#### 2.2 MARKERBOARD

Markerboard shall have a porcelain enamel writing surface and a chalk tray.

Markerboard shall be a factory assembled unit complete in one piece, without joints whenever possible. When markerboard dimensions require delivery in separate sections, components shall be prefabricated at the factory, disassembled for delivery and jointed at the site. Frame and extend the full length of the liquid markerboard. The markerboard shall have a map rail. The map rail with a tackable insert shall extend the full length of the liquid chalkboard, and shall have map hooks with clips for holding sheets of paper. Two map hooks shall be provided for each 1220 mm of map rail. Dry erase markings shall be removable with a felt eraser or dry cloth without ghosting. Each unit shall come complete with an eraser and four different color compatible dry erase markers. The size shall be 1524 mm w x 1219 mm H and shall be located as shown in the Floor plans in Construction Documents.

#### 2.3 MAP RAIL

Provide 50 mm map rail with tackable insert and provide two map hooks with clips for each 1220 mm of map rail. Every markerboard to have map rail.

#### 2.4 NAILS

Nails shall be the size and type best suited for the purpose and shall conform to ASTM F 547. Nails shall be hot-dip galvanized or aluminum when used on exterior work. For siding, length of nails shall be sufficient to extend 40 mm into supports, including wood sheathing over framing. Screws for use where nailing is impractical shall be size best suited for purpose.

### PART 3 EXECUTION

#### 3.1 MOLDING AND INTERIOR TRIM

Molding and interior trim shall be installed straight, plumb, level and with closely fitted joints. Exposed surfaces shall be machine sanded at the mill. Molded work shall be coped at returns and interior angles and mitered at external corners. Intersections of flatwork shall be shouldered to ease any inherent changes in plane. Window and door trim shall be provided in single lengths. Blind nailing shall be used to the extent practicable, and face nailing shall be set and stopped with a nonstaining putty to match the finish applied. Screws shall be used for attachment to metal; setting and stopping of screws shall be of the same quality as required where nails are used.

#### 3.2 WOODWORK ITEMS

##### 3.2.1 Installation and Assembly



Installation and assembly shall be in accordance with manufacturer's printed instructions. Concealed fasteners shall be used. Markerboards shall be attached to the walls with suitable devices to anchor each unit. The Contractor shall furnish and install trim items, accessories and miscellaneous items in total, including but not limited to hardware, grounds, clips, backing materials, in-wall blocking adhesives, brackets, and anchorages incidental to or necessary for a sound, secure, complete and finished installation. Installation shall not be initiated until completion of room painting and finishing operations. Markerboards shall be installed in locations and at mounting heights indicated. Markerboards shall be installed level and plumb, and if applicable doors shall be aligned and hardware shall be adjusted. Damaged units shall be repaired or replaced by the Contractor as directed by the Contracting Officer.

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## SECTION 06410

## LAMINATE CLAD ARCHITECTURAL CASEWORK

11/01

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

- |             |                                                                                                  |
|-------------|--------------------------------------------------------------------------------------------------|
| ANSI A161.2 | (1998) Decorative Laminate Countertops,<br>Performance Standards for Fabricated High<br>Pressure |
| ANSI A208.1 | (1999) Particleboard Mat Formed Woods                                                            |
| ANSI A208.2 | (1994) Medium Density Fiberboard (MDF)                                                           |

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

- |             |                                                                                 |
|-------------|---------------------------------------------------------------------------------|
| ASTM D 1037 | (1999) Evaluating Properties of Wood-Base<br>Fiber and Particle Panel Materials |
|-------------|---------------------------------------------------------------------------------|

## ARCHITECTURAL WOODWORK INSTITUTE (AWI)

- |               |                                                    |
|---------------|----------------------------------------------------|
| AWI Qual Stds | (1999) Architectural Woodwork Quality<br>Standards |
|---------------|----------------------------------------------------|

## BUILDERS HARDWARE MANUFACTURERS ASSOCIATION (BHMA)

- |             |                         |
|-------------|-------------------------|
| BHMA A156.9 | (1994) Cabinet Hardware |
|-------------|-------------------------|

## NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

- |           |                                           |
|-----------|-------------------------------------------|
| NEMA LD 3 | (1995) High-Pressure Decorative Laminates |
|-----------|-------------------------------------------|

## 1.2 GENERAL DESCRIPTION

Work in this section includes laminate clad custom casework, cabinets, vanities, countertops as shown on the drawings and as described in this specification. This Section includes high-pressure laminate surfacing and cabinet hardware. The Contractor shall comply with EPA requirements in accordance with Section 01670 RECYCLED / RECOVERED MATERIALS. All exposed and semi-exposed surfaces, whose finish is not otherwise noted on the drawings or finish schedule, shall be sanded smooth and shall receive a clear finish of polyurethane. Wood finish may be shop finished or field applied in accordance with Section 09900 PAINTING, GENERAL.

## 1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation;

submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. All items designated with a "G", including product literature, calculations, component data, certificates, diagrams, drawings, and samples shall be submitted concurrently in one complete system submittal. Omission of any required submittal item from the package shall be sufficient cause for disapproval of the entire submittal. Unless otherwise indicated in the submittal review commentary, disapproval of any item within the package shall require a re-submittal of the entire system package, in which all deficiencies shall be corrected. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES.

#### SD-02 Shop Drawings

Shop Drawings; G, AE  
Installation; G, AO

Shop drawings showing all fabricated casework items in plan view, elevations and cross-sections to accurately indicate materials used, details of construction, dimensions, methods of fastening and erection, and installation methods proposed. Shop drawing casework items shall be clearly cross-referenced to casework items located on the project drawings. Shop drawings shall include a color schedule of all casework items to include all countertop, exposed, and semi-exposed cabinet finishes to include finish material manufacturer, pattern, and color.

#### SD-03 Product Data

Wood Materials.  
Wood Finishes.  
Finish Schedule.

Descriptive data which provides narrative written verification of all types of construction materials and finishes, methods of construction, etc. not clearly illustrated on the submitted shop drawings. Data shall provide written verification of conformance with AWI Qual Stds for the quality indicated to include materials, tolerances, and types of construction. Both the manufacturer of materials and the fabricator shall submit available literature which describes re-cycled product content, operations and processes in place that support efficient use of natural resources, energy efficiency, emissions of ozone depleting chemicals, management of water and operational waste, indoor environmental quality, and other production techniques supporting sustainable design and products.

#### SD-04 Samples

Plastic Laminates; G, AE.

Two samples of each plastic laminate pattern and color. Samples shall be a minimum of 120 by 170 mm in size.

Cabinet Hardware; G, AE.

One sample of each cabinet hardware item specified.

Wood; G, DO.

Cut and specie of wood for transparent finish. Sample with and without finish.

#### SD-07 Certificates

Quality Assurance.  
Casework.

A quality control statement which illustrates compliance with and understanding of AWI Qual Stds requirements, in general, and the specific AWI Qual Stds requirements provided in this specification. The quality control statement shall also certify a minimum of ten years contractor's experience in laminate clad casework fabrication and construction. The quality control statement shall provide a list of a minimum of five successfully completed projects of a similar scope, size, and complexity.

### 1.4 QUALITY ASSURANCE

Unless otherwise noted on the drawings, all materials, construction methods, and fabrication shall conform to and comply with the premium grade quality standards as outlined in AWI Qual Stds. These standards shall apply in lieu of omissions or specific requirements in this specification. Contractors and their personnel engaged in the work shall be able to demonstrate successful experience with work of comparable extent, complexity and quality to that shown and specified. Contractor must demonstrate knowledge and understanding of AWI Qual Stds requirements for the quality grade indicated.

### 1.5 DELIVERY AND STORAGE

Casework may be delivered knockdown or fully assembled. All units shall be delivered to the site in undamaged condition, stored off the ground in fully enclosed areas, and protected from damage. The storage area shall be well ventilated and not subject to extreme changes in temperature or humidity.

### 1.6 SEQUENCING AND SCHEDULING

Work shall be coordinated with other trades. Units shall not be installed in any room or space until painting, and ceiling installation are complete within the room where the units are located. Floor cabinets shall be installed before finished flooring materials are installed.

### 1.7 PROJECT/SITE CONDITIONS

Field measurements shall be verified as indicated in the shop drawings before fabrication.

## PART 2 PRODUCTS

### 2.1 WOOD MATERIALS

#### 2.1.1 Lumber

All framing lumber shall be kiln-dried Grade III to dimensions as shown on the drawings. Frame front, where indicated on the drawings, shall be

nominal 19 mm hardwood.

#### 2.1.1.1 Standing and Running Trim

Standing or running trim casework components which are specified to receive a transparent finish shall be oak hardwood species, plain sawn. AWI grade shall be premium. Location, shape, and dimensions shall be as indicated on the drawings.

#### 2.1.1.2 Wood for Transparent Stained Finish

Provide rift sawn red oak.

#### 2.1.1.3 Hardwood Plywood

Provide plain sliced red oak.

#### 2.1.2 Panel Products

##### 2.1.2.1 Plywood

All plywood panels used for framing purposes shall be veneer core hardwood plywood, AWI Qual Stds Grade AA. Nominal thickness of plywood panels shall be as indicated in this specification and on the drawings.

##### 2.1.2.2 Particleboard

All particleboard shall be industrial grade, medium density (640 to 800 kg per cubic meter), 19 mm thick. A moisture-resistant particleboard in grade Type 2-M-2 or 2-M-3 shall be used as the substrate for plastic laminate covered countertops, and backsplashes and other areas subjected to moisture. Particleboard shall meet the minimum standards listed in ASTM D 1037 and ANSI A208.1.

##### 2.1.2.3 Medium Density Fiberboard

Medium density fiberboard (MDF) shall be an acceptable panel substrate where noted on the drawings. Medium density fiberboard shall meet the minimum standards listed in ANSI A208.2.

#### 2.2 SOLID POLYMER MATERIAL

Solid surfacing casework components shall conform to the requirements of Section 06650 SOLID POLYMER FABRICATIONS.

#### 2.3 HIGH PRESSURE DECORATIVE LAMINATE (HPDL)

All plastic laminates shall meet the requirements of NEMA LD 3 and ANSI A161.2 for high-pressure decorative laminates. Design, colors, surface finish and texture, and locations shall be as indicated on the drawings. Plastic laminate types and nominal minimum thicknesses for casework components shall be as indicated in the following paragraphs.

##### 2.3.1 Horizontal General Purpose Standard (HGS) Grade

Horizontal general purpose standard grade plastic laminate shall be 1.22 mm (plus or minus 0.127 mm) in thickness. This laminate grade is intended for horizontal surfaces where postforming is not required.



### 2.3.2 Vertical General Purpose Standard (VGS) Grade

Vertical general purpose standard grade plastic laminate shall be 0.71 mm (plus or minus 0.012 mm) in thickness. This laminate grade is intended for exposed exterior vertical surfaces of casework components where postforming is not required.

### 2.3.3 Horizontal General Purpose Postformable (HGP) Grade

Horizontal general purpose postformable grade plastic laminate shall be 1.07 mm (plus or minus 0.127 mm) in thickness. This laminate grade is intended for horizontal surfaces where post forming is required.

### 2.3.4 Vertical General Purpose Postformable (VGP) Grade

Vertical general purpose postformable grade plastic laminate shall be 0.71 mm (plus or minus 0.012 mm) in thickness. This laminate grade is intended for exposed exterior vertical surfaces of components where postforming is required for curved surfaces.

### 2.3.5 Cabinet Liner Standard (CLS) Grade

Cabinet liner standard grade plastic laminate shall be 0.51 mm in thickness. This laminate grade is intended for light duty semi-exposed interior surfaces of casework components.

### 2.3.6 Backing Sheet (BK) Grade

Undecorated backing sheet grade laminate is formulated specifically to be used on the backside of plastic laminated panel substrates to enhance dimensional stability of the substrate. Backing sheet thickness shall be 0.51 mm. Backing sheets shall be provided for all laminated casework components where plastic laminate finish is applied to only one surface of the component substrate.

## 2.4 THERMOSET DECORATIVE OVERLAYS (MELAMINE)

Thermoset decorative overlays (melamine panels) shall be used for all semi-exposed surfaces.

## 2.5 CABINET HARDWARE

Cabinet hardware shall match finish hardware as specified in Section 08710, DOOR HARDWARE. All hardware shall conform to BHMA A156.9, unless otherwise noted, and shall consist of the following components:

### 2.5.1 Adjustable Shelf Supports and Rests

Surface-applied, adjustable shelf supports shall be B24062, wrought brass, nickel plated, with 15 mm (1/2-inch) increment adjustment slots and with provision for screw fastening 150 mm (6 inches) on vertical center.

Flush-applied, adjustable shelf supports shall be B24072, wrought brass, nickel plated with 15 mm (1/2-inch) increment adjustment slots and with provision for screw fastening 150 mm (6 inches) on vertical center.

Shelf rests shall be Type B240Q2, wrought brass, nickel plated. Rests shall have a minimum projection of 20 mm (3/4 inch) and a minimum width of 14 mm (9/16 inch).

Shelf rests for use in drilled holders shall be B84021, wrought steel, nickel plated with 6 mm (1/4 inch) diameter pin, 10 mm (3/8 inch) long, overall length 32 mm .

#### 2.5.2 Cabinet Hinges

Cabinet hinges shall be brass, designated size and finish and shall conform to BHMA A156.9, as follows:

Full mortise, loose-pin hinges shall be B81021, 5-knuckle, button tip, wrought steel, finish 652 or 639.

Semiconcealed cabinet hinges for flush plywood gates and door shall be B21201, 5-knuckle, button tip, finish 639 or 652.

Continuous hinges shall be B81491, wrought steel, chrome plated, 0.81 mm thick with 2.3 mm steel pin, countersunk screw holes 50 mm on center, width when open, 27 mm.

Hinges for lipped door cabinets shall be B81382, 0.81 mm wrought steel, with 50 mm high barrel, fast button tip pins, mortise jamb leaf, finish 639 or 653.

#### 2.5.3 Cabinet Catches

Cabinet catches shall be B83091, friction catch, with wrought steel case and strike and spring-cushioned rubber rollers.

Magnetic catches shall be B43141, Type 1, aluminum case, minimum 20 newton pull.

#### 2.5.4 Pulls

Door and drawer pulls shall be B12012, contemporary-design, cast bronze, 80 mm centers, screw attached from inside of door or drawer.

Knob-type pulls shall be B22132, 40 mm diameter, anodized aluminum knob and shank.

#### 2.5.5 Drawer Slides

Drawer slides shall be B85072, ball bearing full extension drawer slides for attachment to each side of drawer. Rubber stops shall be provided at striking points.

#### 2.5.6 Locks

Locks shall conform to FS A-A1932 and shall be all brass, GBHMA A156. 18, finish US26D, pin-tumbler type with dead bolt, as follows:

Drawer locks and cabinet locks shall be half-mortise, 5 or more pin tumblers, 28 mm diameter cylinder, 8 mm throw dead bolt with brass strike.

Sliding cabinet door locks shall be push-bolt type, 4-pin tumbler, 25 mm diameter cylinder with brass cup strike.

### 2.6 FASTENERS

Nails, screws, and other suitable fasteners shall be the size and type best suited for the purpose and shall conform to ASTM F 547 where applicable.

## 2.7 ADHESIVES, CAULKS, AND SEALANTS

### 2.7.1 Adhesives

Adhesives shall be of a formula and type recommended by AWI. Adhesives shall be selected for their ability to provide a durable, permanent bond and shall take into consideration such factors as materials to be bonded, expansion and contraction, bond strength, fire rating, and moisture resistance. Adhesives shall meet local regulations regarding VOC emissions and off-gassing.

#### 2.7.1.1 Wood Joinery

Adhesives used to bond wood members shall be a Type II for interior use polyvinyl acetate resin emulsion. Adhesives shall withstand a bond test as described in WDMA I.S. 1-A.

#### 2.7.1.2 Laminate Adhesive

Adhesive used to join high-pressure decorative laminate to wood shall be adhesive consistent with AWI and laminate manufacturer's recommendations.

### 2.7.2 Caulk

Caulk used to fill voids and joints between laminated components and between laminated components and adjacent surfaces shall be clear, 100 percent silicone.

### 2.7.3 Sealant

Sealant shall be of a type and composition recommended by the substrate manufacturer to provide a moisture barrier at sink cutouts and all other locations where unfinished substrate edges may be subjected to moisture.

## 2.8 WOOD FINISHES

Paint, stain, varnish and their applications required for laminate clad casework components shall be as indicated in Section 09900 PAINTING, GENERAL. Color and location shall be as indicated on the drawings.

## 2.9 FABRICATION

### 2.9.1 General

Millwork shall be built straight and true conforming to design and details as shown. Work shall be sanded with the grain to remove machine marks and cross scratches. Where practicable, millwork and trim shall be finished and assembled at the mill. Shop assembled surfaces shall be glued where possible and shall be glue blocked at concealed locations. Nailheads shall be set 3 mm and puttied flush and smooth.

### 2.9.2 Precut Openings

Fabricate architectural woodwork with precut openings, to receive hardware, appliances, plumbing fixtures, electrical work and similar items. Locate

openings accurately and use templates or roughing-in diagrams for proper size and shape. Smooth edges of cutouts and, where located in countertops and similar exposures, seal edges of cutouts with a water-resistant coating.

#### 2.9.3 Measurements

Before proceeding with fabrication of woodwork required to be fitted to other construction, obtain measurements and verify dimensions and shop drawings detailed as required for accurate fit.

#### 2.9.4 AWI Construction Style

Provide flush overlay style of construction.

#### 2.9.5 Laminate Clad Countertops

Laminate countertop substrate shall be constructed of 19 mm veneer core plywood. The substrate shall be moisture-resistant where countertops receive sinks, lavatories, or are subjected to liquids. All substrates shall have sink cutout edges sealed with appropriate sealant against moisture. No joints shall occur at any cutouts. A balanced backer sheet is required.

##### 2.9.5.1 Laminate Clad Splashes

Countertop splash substrate shall be 19 mm particleboard, MDF fiberboard or veneer core plywood. Laminate clad backsplash shall be integral with countertop, coved to radius and to dimensions as indicated on the drawings.

Side splashes shall be straight profile and provided loose, to be installed at the time of countertop installation. Back and side splash laminate pattern and color shall match the adjacent countertop laminate.

##### 2.9.5.2 Vertical Surfaces

Plastic Laminate surfaces for counter fronts, gates, and paneling shall be 0.79 mm thick, high pressure laminated, melamine plastic, vertical surface type, conforming to NEMA LD 3, Style D-decorative, Type I, Class 1. Color, pattern, and finish shall be as selected by the Contracting Officer from samples of the approved manufacturer(s).

##### 2.9.5.3 Backing Sheets

Backing sheets for plastic-laminate panels shall be 0.51 mm minimum thick laminated plastic conforming to NEMA LD3.

Backing sheets for plastic-laminate veneer panels shall be bonded to the core material with an adhesive as recommended by the plastic laminate manufacturer.

#### 2.9.6 Laminate Application

##### 2.9.6.1 Tolerances

Flushness, flatness, and joint tolerances of laminated surfaces shall meet the AWI Qual Stds premium grade requirements.

#### 2.9.7 Finishing

##### 2.9.7.1 Filling

No fasteners shall be exposed on laminated surfaces. All nails, screws, and other fasteners in non-laminated cabinet components shall be countersunk and the holes filled with wood filler consistent in color with the wood species.

#### 2.9.7.2 Sanding

All surfaces requiring coatings shall be prepared by sanding with a grit and in a manner that scratches will not show in the final system.

#### 2.9.7.3 Coatings

Types, method of application and location of casework finishes shall be in accordance with the finish schedule, drawings and Section 09900 PAINTING, GENERAL. All cabinet reveals shall be painted.

### 2.10 ARCHITECTURAL WOODWORK TYPES

#### 2.10.1 Vanities

Provide Premium Grade vanities with Solid Surfacing Material countertops.

#### 2.10.2 Wood Display Cabinet

Provide Premium Grade transparent stained finished display cabinet as described in Section 09915, COLOR SCHEDULE.

#### 2.10.3 Rails

Provide premium grade, transparent stained red oak finished chair rails to match existing.

### 2.11 FINISH FOR ARCHITECTURAL WORK

#### 2.11.1 General

The entire finish of architectural woodwork is work of this section, regardless of whether shop applied or applied after installation. To the greatest extent possible, finish architectural woodwork at shop or factory. Defer only final touch-up, cleaning and polishing for time after delivery and installation.

#### 2.11.2 Preparation

Comply with AWI Quality Standards, Section 01500, for sanding, filling countersunk fasteners, back priming and similar preparations for finishing of architectural woodwork as applicable to each unit of work.

#### 2.11.3 Transparent Finish

Refer Section 09900, PAINTING, GENERAL and the drawings.

### 2.12 CABINET HARDWARE AND ACCESSORY MATERIALS

#### 2.12.1 General

Provide cabinet hardware and accessory materials associated with architectural woodwork, except for units which are specified in Section

08700: HARDWARE; BUILDER'S (GENERAL PURPOSE). Except as otherwise indicated, comply with ANSI A 156.9 "American National Standard for Cabinet Hardware", Quality Level, Grade I.

#### 2.12.2 Glass Doors

Kind FT transparent flat type, Class I, Condition A, Quality q3 per ASTM C 1048. Exposed edges shall be seamed.

#### 2.12.3 Glass Shelves

Same type of glass as doors above with exposed edges seamed. Thickness as recommended by glass manufacturer. Show shelf standard spacing and shelving on shop drawings.

### 2.13 PLASTIC-LAMINATE CABINETS

#### 2.13.1 Quality Standard

Comply with AWI Section 400 requirements for laminate cabinets.

#### 2.13.2 Grade

Premium.

#### 2.13.3 AWI Type of Cabinet Construction

Flush overlay.

#### 2.13.4 Reveal Dimension

13 mm

#### 2.13.5 Laminate Cladding for Exposed Surfaces

High-pressure decorative laminate complying with the following requirements:

Horizontal Surfaces Other Than Tops: HGS.

Postformed Surfaces: HGP.

Vertical Surfaces: VGS.

Edges: HGS.

#### 2.13.6 Materials for Semiexposed Surfaces

Provide surface materials indicated below:

Surfaces Other Than Drawer Bodies: Thermoset decorative overlay.

Drawer Sides and Backs: Thermoset decorative overlay.

Drawer Bottoms: Thermoset decorative overlay.

#### 2.13.7 Colors, Patterns, and Finishes

Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:

Match color, pattern, and finish as indicated by laminate manufacturer's designations for these characteristics.

Color as indicated on the Drawings.

## PART 3 EXECUTION

### 3.1 INSTALLATION

Installation shall comply with applicable requirements for AWI Qual Stds premium quality standards. Countertops and fabricated assemblies shall be installed level, plumb, and true to line, in locations shown on the drawings. Cabinets and other laminate clad casework assemblies shall be attached and anchored securely to the floor and walls with mechanical fasteners that are appropriate for the wall and floor construction.

#### 3.1.1 Anchoring Systems

##### 3.1.1.1 Floor

Base cabinets shall utilize a floor anchoring system. Anchoring and mechanical fasteners shall not be visible from the finished side of the casework assembly. Cabinet assemblies shall be attached to anchored bases without visible fasteners. Where assembly abutts a wall surface, anchoring shall include a minimum 13 mm thick lumber or panel product hanging strip, minimum 60 mm width; securely attached to the top of the wall side of the cabinet back.

##### 3.1.1.2 Wall

Cabinet to be wall mounted shall utilize minimum 13 mm thick lumber or panel product hanging strips, minimum 60 mm width; securely attached to the wall side of the cabinet back, both top and bottom.

#### 3.1.2 Countertops

Countertops shall be installed in locations as indicated on the drawings. Countertops shall be fastened to supporting casework structure with mechanical fasteners, hidden from view. All joints formed by the countertop or countertop splash and adjacent wall surfaces shall be filled with a clear silicone caulk.

##### 3.1.2.1 Loose Splashes

Loose back and side splashes shall be adhered to both the countertop surface perimeter and the adjacent wall surface with adhesives appropriate for the type of materials to be adhered. Joints between the countertop surface and splash shall be filled with clear silicone caulk in a smooth consistent concave bead. Bead size shall be the minimum necessary to fill the joint and any surrounding voids or cracks.

##### 3.1.3 Hardware

Casework hardware shall be installed in types and locations as indicated on the drawings. Where fully concealed European-style hinges are specified to be used with particleboard or fiberboard doors, the use of plastic or synthetic insertion dowels shall be used to receive 5 mm "Euroscrews". The use of wood screws without insertion dowels is prohibited.

##### 3.1.4 Doors, Drawers and Removable Panels

The fitting of doors, drawers and removable panels shall be accomplished within target fitting tolerances for gaps and flushness in accordance with AWI Qual Stds premium grade requirements.

### 3.1.5 Plumbing Fixtures

Sinks, sink hardware, and other plumbing fixtures shall be installed in locations as indicated on the drawings and in accordance with Section 15400 PLUMBING, GENERAL PURPOSE.

### 3.1.6 Glass

Glass and glazing shall be installed in the casework using methods and materials specified in Section 08810 GLASS AND GLAZING in locations as indicated on the drawings.

-- End of Section --



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## DIVISION 06 - WOODS &amp; PLASTICS

## SECTION 06650

## SOLID POLYMER (SOLID SURFACING) FABRICATIONS

10/00

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## SECTION 06650

SOLID POLYMER (SOLID SURFACING) FABRICATIONS  
10/00

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z124.3 (1995) Plastic Lavatories

ANSI Z124.6 (1997) Plastic Sinks

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 570 (1998) Water Absorption of Plastics

ASTM D 638M (1998) Tensile Properties of Plastics  
(Metric)

ASTM D 696 (1998) Coefficient of Linear Thermal  
Expansion of Plastics Between Minus 30  
degrees C and 30 degrees C

ASTM D 2583 (1995) Indentation Hardness of Rigid  
Plastics by Means of a Barcol Impressor

ASTM E 84 (1999) Surface Burning Characteristics of  
Building Materials

ASTM G 21 (1996) Determining Resistance of Synthetic  
Polymeric Materials to Fungi

ASTM G 22 (1976; R 1996) Determining Resistance of  
Plastics to Bacteria

## NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA LD 3 (1995) High Pressure Decorative Laminates

## 1.2 GENERAL DESCRIPTION

Work in this section includes countertops and other items utilizing solid polymer (solid surfacing) fabrication as shown on the drawings and as described in this specification.

## 1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation;

submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

#### SD-02 Shop Drawings

Shop Drawings; G, AE.  
Installation; G, AO.

Shop Drawings indicating locations, dimensions, component sizes, fabrication and joint details, attachment provisions, installation details, and coordination requirements with adjacent work.

#### SD-03 Product Data

Solid polymer material.  
Qualifications.  
Fabrications.

Product data indicating product description, fabrication information, and compliance with specified performance requirements for solid polymer, joint adhesive, sealants, and heat reflective tape. Both the manufacturer of materials and the fabricator shall submit a detailed description of operations and processes in place that support efficient use of natural resources, energy efficiency, emissions of ozone depleting chemicals, management of water and operational waste, indoor environmental quality, and other production techniques supporting sustainable design and products.

#### SD-04 Samples

Material; G, AE.

A minimum 100 by 100 mm sample of each color and pattern for approval. Samples shall indicate full range of color and pattern variation. Approved samples shall be retained as a standard for this work.

#### SD-06 Test Reports

Solid polymer material.

Test report results from an independent testing laboratory attesting that the submitted solid polymer material meets or exceeds each of the specified performance requirements.

#### SD-07 Certificates

Fabrications.  
Qualifications.

Solid polymer manufacturer's certification attesting to fabricator qualification approval.

#### SD-10 Operation and Maintenance Data

Solid polymer material.

Celean-up.

A minimum of six copies of maintenance data indicating manufacturer's care, repair and cleaning instructions. Maintenance video shall be provided, if available. Maintenance kit for matte finishes shall be submitted.

#### 1.4 DELIVERY, STORAGE AND HANDLING

Materials shall not be delivered to project site until areas are ready for installation. Materials shall be stored indoors and adequate precautions taken to prevent damage to finished surfaces. Protective coverings shall be provided to prevent physical damage or staining following installation, for duration of project.

#### 1.5 WARRANTY

Manufacturer's warranty of ten years against defects in materials, excluding damages caused by physical or chemical abuse or excessive heat, shall be provided. Warranty shall provide for material and labor for replacement or repair of defective material for a period of ten years after component installation.

#### 1.6 QUALIFICATIONS

To insure warranty coverage, solid polymer fabricators shall be certified to fabricate by the solid polymer material manufacturer being utilized. All fabrications shall be marked with the fabricator's certification label affixed in an inconspicuous location. Fabricators shall have a minimum of 5 years of experience working with solid polymer materials.

### PART 2 PRODUCTS

#### 2.1 MATERIAL

Solid polymer material shall be a homogeneous filled solid polymer; not coated, laminated or of a composite construction; meeting ANSI Z124.3 and ANSI Z124.6 requirements. Material shall have minimum physical and performance properties specified. Superficial damage to a depth of 0.25 mm shall be repairable by sanding or polishing. Material thickness shall be as indicated on the drawings. In no case shall material be less than 6 mm in thickness.

##### 2.1.1 Cast, 100 Percent Acrylic Polymer Solid Surfacing Material

Cast, 100 percent acrylic solid polymer material shall be composed of acrylic polymer, mineral fillers, and pigments and shall meet the following minimum performance requirements:

PROPERTY	REQUIREMENT (min. or max.)	TEST PROCEDURE
Tensile Strength	422 kg/cm <sup>2</sup>	ASTM D 638M
Hardness	55-Barcol Impressor (min.)	ASTM D 2583
Thermal Expansion	.0000386cm/cm/degC	ASTM D 696

PROPERTY	REQUIREMENT (min. or max.)	TEST PROCEDURE
Boiling water Surface Resistance	No Change	NEMA LD 3-3.05
High Temperature Resistance	No Change	NEMA LD 3-3.06
Impact Resistance (Ball drop)		NEMA LD 3-303
6.4 mm sheet	910 mm, 227 g ball, no failure	
12.7 mm sheet	3550 mm, 227 g ball, no failure	
19 mm sheet	5070 mm, 227 m ball, no failure	
Mold & Mildew Growth	No growth	ASTM G 21
Bacteria Growth	No Growth	ASTM G 22
Liquid Absorption (Weight in 24 hrs.)	0.1% max.	ASTM D 570
Flammability		ASTM E 84
Flame Spread	25 max.	
Smoke Developed	30 max	

#### 2.1.2 Material Patterns and Colors

Patterns and colors for all solid polymer components and fabrications shall be those indicated on the project drawings. Pattern and color shall occur, and shall be consistent in appearance, throughout the entire depth (thickness) of the solid polymer material.

#### 2.1.3 Surface Finish

Exposed finished surfaces and edges shall receive a uniform appearance. Exposed surface finish shall be matte; gloss rating of 5-20.

### 2.2 ACCESSORY PRODUCTS

Accessory products, as specified below, shall be manufactured by the solid polymer manufacturer or shall be products approved by the solid polymer manufacturer for use with the solid polymer materials being specified.

#### 2.2.1 Seam Adhesive

Seam adhesive shall be a two-part adhesive kit to create permanent, inconspicuous, non-porous, hard seams and joints by chemical bond between solid polymer materials and components to create a monolithic appearance of the fabrication. Adhesive shall be approved by the solid polymer

manufacturer. Adhesive shall be color-matched to the surfaces being bonded where solid-colored, solid polymer materials are being bonded together. The seam adhesive shall be clear or color matched where particulate patterned, solid polymer materials are being bonded together.

#### 2.2.2 Silicone Sealant

Sealant shall be a mildew-resistant, FDA and UL listed silicone sealant or caulk in a clear formulation. The silicone sealant shall be approved for use by the solid polymer manufacturer. Sealant shall be used to seal all expansion joints between solid polymer components and all joints between solid polymer components and other adjacent surfaces such as walls, floors, ceiling, and plumbing fixtures.

### 2.3 FABRICATIONS

Components shall be factory or shop fabricated to the greatest extent practical to sizes and shapes indicated, in accordance with approved Shop Drawings and manufacturer's requirements. Factory cutouts shall be provided for sinks, lavatories, and plumbing fixtures where indicated on the drawings. Contours and radii shall be routed to template, with edges smooth. Defective and inaccurate work will be rejected.

#### 2.3.1 Joints and Seams

Joints and seams shall be formed between solid polymer components using manufacturer's approved seam adhesive. Joints shall be inconspicuous in appearance and without voids to create a monolithic appearance.

#### 2.3.2 Edge Finishing

Rout and finish component edges to a smooth, uniform appearance and finish. Edge shapes and treatments, including any inserts, shall be as detailed on the drawings. Rout all cutouts, then sand all edges smooth. Repair or reject defective or inaccurate work.

#### 2.3.3 Counter and Vanity Top Splashes

Backsplashes and end splashes shall be fabricated from 13 mm thick solid surfacing material and shall be 100 mm high. Backsplashes and end splashes shall be provided for all counter tops and vanity tops at locations indicated on the drawings. Backsplashes shall be shop fabricated and be loose, to be field attached.

#### 2.3.4 Counter and Vanity Tops

All solid surfacing, solid polymer counter top and vanity top components shall be fabricated from 13 mm thick material. Edge details, dimensions, locations, and quantities shall be as indicated on the Drawings. Counter tops shall be complete with 100 mm high loose at all locations. Attach 50 mm wide reinforcing strip of polymer material under each horizontal counter top seam.

##### 2.3.4.1 Counter Top With Sink

###### A. Stainless Steel or Vitreous China Sink.

Countertops with sinks shall include cutouts to template as furnished by the sink manufacturer. Manufacturer's standard sink mounting

hardware for stainless steel or vitreous china rimless installation shall be provided. Seam between sink and counter top shall be sealed with silicone sealant. Sink, faucet, and plumbing requirements shall be in accordance with Section 15400 PLUMBING, GENERAL PURPOSE.

## PART 3 EXECUTION

### 3.1 COORDINATION

In most instances, installation of solid polymer fabricated components and assemblies will require strong, correctly located structural support provided by other trades. To provide a stable, sound, secure installation, close coordination is required between the solid polymer fabricator/installer and other trades to insure that necessary structural wall support, cabinet counter top structural support, proper clearances, and other supporting components are provided for the installation of wall panels, countertops, shelving, and all other solid polymer fabrications to the degree and extent recommended by the solid polymer manufacturer. Contractor shall appropriate staging areas for solid polymer fabrications.

### 3.2 INSTALLATION

#### 3.2.1 Components

All components and fabricated units shall be installed plumb, level, and rigid. Field joints between solid polymer components to provide a monolithic appearance shall be made using solid polymer manufacturer's approved seam adhesives, with joints inconspicuous in the finished work. Metal or vitreous china sinks and lavatory bowls shall be attached to counter tops using solid polymer manufacturer's recommended clear silicone sealant and mounting hardware. Solid polymer sinks and bowls shall be installed using a color-matched seam adhesive. Plumbing connections to sinks and lavatories shall be made in accordance with Section 15400 PLUMBING, GENERAL PURPOSE.

##### 3.2.1.1 Loose Counter Top Splashes

Loose splashes shall be mounted in locations as noted on the drawings. Loose splashes shall be adhered to the counter top with a color matched silicone sealant when the solid polymer components are solid colors. Adhesion of particulate patterned solid polymer splashes to counter tops shall utilize a clear silicone sealant.

##### 3.2.2 Silicone Sealant

A clear, silicone sealant or caulk shall be used to seal all expansion joints between solid polymer components and all joints between solid polymer components and other adjacent surfaces such as walls, floors, ceiling, and plumbing fixtures. Sealant bead shall be smooth and uniform in appearance and shall be the minimum size necessary to bridge any gaps between the solid surfacing material and the adjacent surface. Bead shall be continuous and run the entire length of the joint being sealed.

##### 3.2.3 Plumbing

Plumbing connections to sinks and lavatories shall be made in accordance with Section 15400 PLUMBING, GENERAL PURPOSE.

### 3.3 CLEAN-UP

Components shall be cleaned after installation and covered to protect against damage during completion of the remaining project items. Components damaged after installation by other trades will be repaired or replaced at the General Contractor's cost. Component supplier will provide a repair/replace cost estimate to the General Contractor who shall approve estimate before repairs are made.

-- End of Section --



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## DIVISION 07 - THERMAL &amp; MOISTURE PROTECTION

## SECTION 07132

## HOT FLUID-APPLIED WATERPROOFING

**09/98**

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## SECTION 07132

HOT FLUID-APPLIED WATERPROOFING  
09/98

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 578	(2001) Rigid, Cellular Polystyrene Thermal Insulation
ASTM D 1621	(2000) Standard Test Method For Compressive Properties of Rigid Cellular Plastics

## 1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

## SD-03 Product Data

System Description; G, AE.  
Reinforcing Fabric; G, AE.  
Protection Course; G, AE.

Manufacturer's data including technical information which indicates full compliance with this section.

Applications.

Manufacturer's installation instructions, before delivery of materials to the site. Instructions shall specify acceptable range of asphalt application temperatures and the maximum temperature for holding asphalt in a heated condition.

## SD-07 Certificates

Materials; G, AE.

Certificates from independent testing laboratory attesting that materials manufactured and shipped to jobsite meets the specified

requirements.

Certification from manufacturer that installer is and authorized installer having specified minimum experience.

### 1.3 QUALIFICATIONS

Work shall be performed by manufacturer authorized installer is an authorized installer with at least 5-years documented experience installing specified waterproofing system. Membrane Manufacturer shall have minimum 10-years experience manufacturing specified waterproofing system.

### 1.4 DELIVERY, STORAGE AND HANDLING

Waterproofing materials shall be delivered to the project site in the original sealed containers bearing the name of the manufacturer, contents and brand name. Products shall be protected from temperature extremes as recommended by the manufacturer. Sheet goods shall be protected from sunlight, moisture damage, and moisture absorption in a weathertight enclosure or shall be stored off the ground on pallets, and covered on top and all sides with breathable-type canvas tarpaulins. Plastic sheets cause condensation buildup and therefore shall not be used to cover waterproofing materials. Damaged or deteriorated materials shall be removed from project site.

### 1.5 WARRANTY

Provide manufacturer's warranty of watertightness and materials, including labor and materials for 10-years period, for all components of waterproofing system.

## PART 2 PRODUCTS

### 2.1 HOT FLUID-APPLIED WATERPROOFING

#### 2.1.1 Manufacturer

Provide all materials except concrete and insulation from a single-source manufacturer.

### 2.2 PRIMER

Primer for waterproofing shall be manufacturer's recommended surface conditioner.

### 2.3 HOT, FLUID-APPLIED RUBBERIZED ASPHALT MEMBRANE

Conform to CGSB 37.50-M89 and the following properties.

#### 2.3.1 Membrane Properties

PROPERTY	TEST METHOD	TYPICAL RESULT
Flash point	ASTM D 92	502°F
	CGSB-37.50-M89	(261°C)
Penetration	ASTM D 5329	98 mm @77°F (25°C)
	CGSB-37.50-M89	187 mm @122°F (50°C)

Flow	ASTM D 5329 CGSB-37.50-M89	1.0 mm @ 140°F (60°C)
Toughness	CGSB-37.50-M89	16.0 Joules
Ratio of Toughness to Peak Load	CGSB-37.50-M89	0.069
Water Vapor Permeability	ASTM E 96, PROCEDURE E CGSB-37.50-M89	0.3 ng/Pa(s)M2
Water Absorption	CGSB-37.50-M89	.11 gram weight gain
Low Temperature Flexibility (-25°C)	CGSB-37.50-M89	No delamination, or adhesion loss, cracking
Low Temperature Crack Bridging Capability	CGSB-37.50-M89	No cracking, adhesion loss, or splitting
Heat Stability	CGSB-37.50-M89	No change in viscosity, penetration, flow or low temperature flexibility
Viscosity	CGSB-37.50-M89	11.0 seconds
Water Resistance (5 days/50°C)	CGSB-37.50-M89	No delamination, blistering, emulsification, or deterioration
Softening Point	ASTM D 36	180°F (82°C)
Elongation	ASTM D 5329	1000% minimum
Resiliency	ASTM D 3407	40% minimum
Bond to Concrete	ASTM D 3407	Pass 0°F (-18°C)
Acid Resistance	ASTM D 896	Pass-50% Nitric Acid
Solids Content		100-Percent, No Solvents
Post Consumer Recycled Material Content		25-Percent

## 2.4 REINFORCEMENT AND FLASHING FABRICS

### 2.4.1 Flashing

1.5 mm (60 mil) thickness uncured neoprene sheet.

### 2.4.2 Reinforcement

#### 2.4.2.1 Horizontal Reinforcing

Spun bonded polyester fabric.

#### 2.4.2.2 Vertical Reinforcing

Woven fiberglass fabric.

#### 2.4.3 Adhesives and Sealants

Adhesives and sealants shall be manufacturer's standard products.

#### 2.5 PROTECTION COURSE

2 mm (85 mil) Fiberglass reinforced, rubberized asphalt sheet.

#### 2.6 INSULATION BOARDS

Insulation boards shall be rigid, extruded polystyrene, ASTM C 578 Type VI or VII; minimum compressive strength 40 psi per ASTM D 1621; maximum water absorption 0.1 percent per ASTM C 272. On bottom layer, provide insulation boards grooved for drainage.

#### 2.7 CONCRETE

As specified in Section 03300 CONCRETE. Allow concrete topping to cure thoroughly. Test water vapor emission rate in accordance with manufacturer's recommendations. Do not proceed until water vapor emission rate is within guidelines recommended by Manufacturer.

#### 2.8 GEO FABRIC

Non-woven, needle-punched polypropylene, 94 gm/m<sup>2</sup> min., with treatment for U-V stability.

### PART 3 EXECUTION

#### 3.1 SURFACE PREPARATION

Surfaces scheduled for waterproofing shall be prepared in accordance with waterproofing manufacturer's recommendations. Surface preparation shall be approved prior to waterproofing application.

##### 3.1.1 Protection of Surrounding Areas

Before starting the waterproofing work, the surrounding areas and surfaces shall be protected from spillage and migration of waterproofing onto other work. Drains and conductors shall be protected from clogging with asphalt.

##### 3.1.2 Concrete Surfaces

Surfaces shall be properly cured, free of form release agents, oil, grease, dirt, laitance, loose material, frost, debris and other contaminants. Form ties shall be cut flush with surface. Sharp protrusions and form match lines shall be removed. Holes, voids, spalled areas and cracks which can damage waterproofing materials shall be repaired. Rough surfaces shall be parged with a well-adhering coat of cement mortar.

#### 3.2 HOT-FLUID-APPLIED WATERPROOFING

Waterproofing shall be applied when temperature and humidity conditions are within manufacturer's recommended range. Heating kettles and tanks shall be double jacketed and provided with automatic thermostatic control capable of maintaining rubberized asphalt temperature. Controls shall be

calibrated and maintained in working order for duration of work. At time of application, rubberized asphalt shall be heated to the equiviscous temperature recommended by manufacturer. Rubberized asphalt with a temperature not conforming to the manufacturer's recommendations shall be returned to the kettle. Rubberized asphalt that is overheated according to the manufacturer's guidelines shall be removed from site.

### 3.2.1 Waterproofing

Apply rubberized asphalt at a rate to provide a continuous, monolithic coat of 2.3 mm (90 mil) minimum, into which is fully embedded a layer of reinforcing sheet. Overlap reinforcing 25-50 mm (1-2 inches). Apply a second continuous monolithic coat of membrane at an average thickness of 3.2 mm (125 mil). Total membrane thickness shall be 5.5 mm (215 mil) minimum.

### 3.2.2 Protection Layer

Embed protection layer into hot membrane. Overlap adjoining edges 50-75 mm (2-3 inches).

### 3.2.3 Insulation

Place insulation over completed waterproofing. Place insulation in two layers with joints staggered. Place grooved insulation on bottom layer, with grooves parallel to slope.

## 3.3 FLOOD TESTING

Prior to concealment, waterproofed roof over occupied spaces shall be tested for watertightness. Drains shall be plugged and floors shall be submerged with 50 mm of clean water. Water shall be permitted to stand for a minimum of 48 hours. If leaks occur, water shall be drained and repairs made in accordance with manufacturer's instructions. Upon completion of repairs, roofs shall be flooded with 75 mm of clean water and flood testing shall be repeated for minimum of 24 hours from the time each leak is repaired. Waterproofing system shall be completely watertight, and shall be approved in writing before covering up with other materials.

## 3.4 CLEAN-UP

Surfaces of other work which are stained with waterproofing materials shall be cleaned with a cleaner recommended by waterproofing manufacturer.

## 3.5 PROTECTION OF COMPLETED WORK

### 3.5.1 Horizontal Waterproofing

The completed waterproofing work shall be protected from damage during and after construction. Protective covering shall be placed immediately before proceeding with the work which will conceal the waterproofing.

### 3.5.2 Vertical Waterproofing

Waterproofing against which backfill is to be placed shall be protected with a single layer of insulation board. Insulation boards shall be pressed into the final mopping while the waterproofing is still hot, with edges of boards placed into moderate contact and joints staggered. Where

surfaced insulation board is used, the surfaced side shall face outward. Boards shall be carefully and neatly fitted around projections, and shall cover the entire surface of the waterproofing materials. Waterproofing system not covered with protection board shall be protected to prevent damage from subsequent building operations. Installed boards shall not remain exposed at the end of a work day.

-- End of Section --

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## SECTION 07170

## BENTONITE GEOTEXTILE WATERPROOFING

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 903	(1998) Standard Test Method for Peel or Stripping Strength of Adhesive Bonds
ASTM D 5385	(1993) Standard Test Method for Hydrostatic Pressure Resistance of Waterproofing Membranes
ASTM D 5084	(2000) Standard Test Method for Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter
ASTM D 4632	(1991) Standard Test Method for Grab Breaking Load and Elongation of Geotextiles
ASTM D 4833	(2000) Standard Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products
ASTM D 1970	(2001) Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protections
ASTM D 751	(2000) Standard Test Method for Coated Fabrics
ASTM D 882	(2000) Standard Test Method for Tensile Properties of Thin Plastic Sheeting
ASTM E 96	(2000) Standard Test Methods for Water Vapor Transmission of Materials

## 1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

## SD-03 Product Data

Product Date; G, AE.

Manufacturer's product data, with complete general and specific installation instructions, recommendations, and limitations.

## SD-07 Certificates

Submit Certificate(s)

Signed by manufacturer certifying materials comply with specified performance characteristics and physical requirements. Submit certification that waterproofing system and accessory materials are supplied by a single-source manufacturer.

Submit written certification that installer has current Approved Applicator status with waterproofing material manufacturer.

## 1.3 QUALITY ASSURANCE

## 1.3.1 Installer Qualifications

Installing company shall have at least three (3) years experience in work of the type required by this section, who can comply with manufacturer's warranty requirements, and who is an Approved Applicator as determined by waterproofing system manufacturer.

## 1.3.2 Manufacturer Qualifications

Bentonite geotextiles waterproofing and all accessory products shall be provided by a single manufacturer with a minimum of 10 years experience in the direct production and sales of bentonite waterproofing systems. Manufacturer shall be capable of providing field service representation during construction, approving an acceptable installer, recommending appropriate installation methods, and conducting a final inspection of the bentonite waterproofing system applied.

## 1.3.3 Pre-Installation Conference

A pre-installation conference shall be held prior to commencement of field installation to establish procedures to maintain required working conditions and to coordinate this work with related and adjacent work. Verify that final waterproofing details comply with waterproofing manufacturer's current installation requirements and recommendations.

## 1.3.4 Materials

Obtain bentonite waterproofing and accessory materials from a single manufacturer to assure material compatibility.

## 1.3.5 Inspection

Manufacturer's representative shall inspect waterproofing installation periodically during application to verify that waterproofing has been installed in accordance with manufacturer's guidelines and recommendations.

## 1.3.6 Water Sample Test

Obtain ground water sample and test in accordance with manufacturer is instructions to determine type of bentonite system (standard sodium bentonite or contaminate resistant (CR) sodium bentonite) to be utilized on the project.

#### 1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

##### 1.4.1 Delivery and Handling

Deliver materials in factory sealed and labeled packaging. Sequence deliveries to avoid delays, while minimizing on-site storage. Handle and store following manufacturer's instructions, recommendations and material safety data sheets. Protect from construction operation related damage, as well as, damage from weather, excessive temperatures and prolonged sunlight. Remove damaged material from site and dispose of in accordance with applicable regulations.

##### 1.4.2 Storage

Do not double-stack pallets during shipping or storage. Protect waterproofing materials from moisture, excessive temperatures and sources of ignition. Provide cover, top and all sides, for materials stored on-site, allowing for adequate ventilation.

#### 1.5 PROJECT CONDITIONS

##### 1.5.1 Substrate Condition

Proceed with work only when substrate construction and preparation work is complete and in condition to receive waterproofing system.

##### 1.5.2 Weather Conditions

Perform work only when existing and forecasted weather conditions are within the guidelines established by the manufacturer of the waterproofing materials. Do not apply waterproofing materials into standing water or icing conditions.

#### 1.6 WARRANTY

##### 1.6.1 Waterproofing Warranty

Upon completion and acceptance of the work required by this section, provide a manufacturer's written five (5) year system warranty covering replacement of materials and including both materials and labor in the event of leakage. Manufacturer's warranty shall be independent from any other warranties made by the Contractor under requirements of the Contract Documents and may run concurrent with said warranties.

## PART 2 PRODUCTS

### 2.1 MATERIALS

#### 2.1.1 Sodium Bentonite

Select granular bentonite containing approximately 90% montmorillonite with 10% maximum unaltered volcanic ash and other native sediments. Free Swell Rating: 2 grams sifted into deionized water swells to occupy a minimum volume of 16 cc. Grading: Granular bentonite passes 90% through a 20-mesh

sieve and less than 10% through a 200-mesh sieve.

## 2.2 BENTONITE GEOTEXTILE WATERPROOFING

1.2 x 4.4m roll of interlocked geotextiles encapsulating a minimum of 5.3 kg per sq m of granular sodium bentonite with a vapor barrier HDPE sheet integrally bonded to the outside of the non-woven geotextiles. Composite shall consist of one woven and one non-woven polypropylene geotextiles, interlocked using a needle-punching process. The non-woven geotextiles fibers shall pass through the bentonite layer and integrate into the woven geotextiles to produce several interlocks each square inch (6.45 sq. cm) over the entire surface area of product.

Waterproofing shall have the following properties:

Property	Test Method	Value
Peel Adhesion to Concrete	ASTM D 903 mod.	2.6 kN/m min.
Hydrostatic Pressure Resistance	ASTM D 5385 mod.	70 m
Permeability	ASTM D 5084	1 x 10 <sup>-9</sup> cm/sec.
Grab Tensile Strength	ASTM D 4632	422 N
Puncture Resistance	ASTM D 4833	445 N min.
Low Temperature Flexibility	ASTM D 1970	Unaffected at -32C
Geotextile Interlock Peel	ASTM D 4632	65 N
Water Vapor Transmission Rate	ASTM E 96 (B)	0.03 grains/hr/ft <sup>2</sup>

Integral vapor barrier shall have the following properties:

Nominal Thickness		5 mils
Tensile Strength	ASTM D 882	30 lbs.
Elongation	ASTM D 882	450%
Grab Strength	ASTM D 751	55 lbs.
Water Vapor Transmission	ASTM E 96 (B)	0.034 grains/hr/ft <sup>2</sup>

## 2.3 WATERPROOFING ACCESSORIES

All accessory waterproofing materials shall be provided by the bentonite waterproofing manufacturer or shall have manufacturer's written approval for substitution.

1. Trowel grade sodium bentonite compound used as detailing mastic around penetrations, corner transitions and grade terminations.
2. Bentonite Tubes: 50 mm diameter x 600 mm long, water soluble tube container filled with granular sodium bentonite; 1.36 kg per tube total weight.
3. Bentonite Waterstop: 22.7 kg bag of specially processed dry granular sodium bentonite.

## PART 3 EXECUTION

### 3.1 GENERAL

Comply with manufacturer's product data, including product application and installation instructions, as well as, manufacturer's shipping and storage recommendations.

### 3.2 INSPECTION

Examine conditions of substrates and other conditions where this section work is to be performed and notify Contracting Officer's Representative, in writing, of circumstances detrimental to the proper completion of the work. Do not proceed with work until unsatisfactory conditions are corrected and are acceptable for compliance with manufacturer's warranty requirements.

### 3.3 SURFACE PREPARATION

Protect adjacent work areas and finish surfaces from damage or contamination from waterproofing products during installation operations.

#### 3.3.1 Soil Substrates

Grade substrates to well-leveled surface without voids and debris. Compact to minimum 89-percent Modified Proctor density. If substrate consists of large aggregate, place a high-strength geotextiles layer over the aggregate and then provide several inches of compacted soil or sand for uniform support and containment of waterproofing sheets.

### 3.4 GENERAL INSTALLATION GUIDELINES

Prevent bentonite waterproofing products from hydrating by protecting from water before material is contained with overburden or backfill. When threat of rain is imminent, installed bentonite products not already contained by concrete slab shall be covered prevent to hydration. Remove cover prior to placing concrete slabs. Remove, discard, and replace any bentonite materials that become damp or wet prior to backfilling.

Install Waterproofing System as recommended by the manufacturer.

#### 3.4.1 Expansion Joints

Trowel 3 mm thick, 150 mm wide layer of bentonite centered under expansion joints. Install a 600 mm wide strip of the specified membrane centered under expansion joints. Then place the main course of the waterproofing membrane.

### 3.5 UNDER SLAB INSTALLATION

Install bentonite waterproofing under all floor slabs, footings, elevator pits and grade walls.

Apply minimum 12 mm thickness layer of Waterstoppage (granular bentonite) extending around each penetration a minimum radius of 6" (150 mm).

Place bentonite waterproofing directly on properly prepared substrate with vapor barrier facing down, with adjoining edges overlapped a minimum of 100 mm. Stagger sheet end seams a minimum of 600 mm. Mechanically fasten or staple waterproofing as required to prevent movement from construction operations or concrete placement. When the slab is poured in sections, extend waterproofing a minimum 300 mm beyond the slab edge to enable proper overlapping.

Cut bentonite waterproofing to fit snugly around penetrations. Around base of penetrations trowel 18 mm thick fillet of bentonite and extend onto waterproofing sheet.

Provide a minimum of 300 mm overlap between underslab and vertical wall waterproofing.

Inspect finished bentonite installation and repair any damaged material prior to concrete placement. Assure that waterproofing is not displaced during concrete placement.

### 3.6 CLEAN UP

In areas where adjacent finished surfaces are soiled by work of this Section, consult manufacturer of surfaces for cleaning advice and conform to their recommendations and instructions. Remove all tools, equipment and remaining product on-site. Dispose of section work debris and damaged product following all applicable regulations.

-- End of Section --

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## SECTION 07190

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**09/99**

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## SECTION 07190

## WATER REPELLENTS

09/99

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS  
(AASHTO)

AASHTO T 259	(1980) Resistance of Concrete to Chloride Ion Penetration
AASHTO T 260	(1995) Sampling and Testing for Chloride Ion in Concrete and Concrete Raw Materials

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 642	(1997) Density, Absorption, and Voids in Hardened Concrete
ASTM C 672	(1992) Scaling Resistance of Concrete Surfaces Exposed to Deicing Chemicals
ASTM D 1653	(1993) Water Vapor Transmission of Organic Coating Films
ASTM D 2369	(1998) Volatile Content of Coatings
ASTM D 3278	(1996) Flash Point of Liquids by Small Scale Closed-Cup Apparatus
ASTM E 514	(1990; R 1996) Water Penetration and Leakage Through Masonry
ASTM G 53	(1996) Operating Light- and Water-Exposure Apparatus (Fluorescent UV-Condensation Type) for Exposure of Nonmetallic Materials

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910.1000	Air Contaminants
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## 1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

## SD-03 Product Data

Water repellents

## SD-06 Test Reports

Water absorption

Accelerated weathering

Resistance to chloride ion penetration

Moisture vapor transmission

Scaling resistance

Water Penetration and Leakage

## SD-08 Manufacturer's Instructions

Application instructions

Provide manufacturer's instructions including preparation, application, recommended equipment to be used, safety measures, and protection of completed application.

Manufacturer's material safety data sheets

## 1.3 QUALITY ASSURANCE

## 1.3.1 Qualifications

- a. Manufacturer's qualifications: Minimum five years record of successful in-service experience of water repellent treatments manufactured for concrete application.
- b. Applicator's qualifications: Minimum five years successful experience in projects of similar scope using specified or similar treatment materials and manufacturer's approval for application.

## 1.3.2 Evidence of Acceptable Variation

If a product proposed for use does not conform to requirements of the referenced specification, submit for approval to the Contracting Officer, evidence that the proposed product is either equal to or better than the product specified. Include the following:

- a. Identification of the proposed substitution;
- b. Reason why the substitution is necessary;
- c. A comparative analysis of the specified product and the proposed substitution, including tabulations of the composition of pigment and vehicle;
- d. The difference between the specified product and the proposed substitution; and
- e. Other information necessary for an accurate comparison of the

proposed substitution and the specified product.

#### 1.4 PRE-INSTALLATION

##### 1.4.1 Pre-Installation Meeting

- a. Attend pre-installation meeting required prior to commencement of concrete installation.
- b. Review procedures and coordination required between water repellent treatment work and work of other trades which could affect work to be performed under this section of the work.
- c. Convene additional pre-installation meeting prior to water repellent treatment application for coordination with work not previously coordinated including joint sealants.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

Deliver materials in original sealed containers, clearly marked with the manufacturer's name, brand name, type of material, batch number, percent solids by weight and volume, and date of manufacturer. Store materials off the ground, in a dry area where the temperature will be not less 10 degrees C nor more than 29 degrees C.

#### 1.6 SAFETY METHODS

Apply coating materials using safety methods and equipment in accordance with Section 01575N, "Temporary Environmental Controls," and the following:

##### 1.6.1 Toxic Materials

To protect personnel from overexposure to toxic materials, conform to the most stringent guidance of:

- a. The coating manufacturer when using solvents or other chemicals. Use impermeable gloves, chemical goggles or face shield, and other recommended protective clothing and equipment to avoid exposure of skin, eyes, and respiratory system. Conduct work in a manner to minimize exposure of building occupants and the general public.
- b. 29 CFR 1910.1000.
- c. Threshold Limit Values (R) of the American Conference of Governmental Industrial Hygienists.
- d. Manufacturer's material safety data sheets.

#### 1.7 ENVIRONMENTAL CONDITIONS

##### 1.7.1 Weather and Substrate Conditions

Do not proceed with application of water repellents under any of the following conditions, except with written recommendations of manufacturer.

- a. Ambient temperature is less than 4 degrees C.
- b. Substrate faces have cured less than one month.

- c. Rain or temperature below 4 degrees C are predicted for a period of 24 hours before or after treatment.
- d. Earlier than three days after surfaces are wet.
- e. Substrate is frozen or surface temperature is less than 4 degrees C and falling.

#### 1.7.2 Moisture Condition

Determine moisture content of substrate meets manufacturer's requirements prior to application of water repellent material.

### 1.8 SEQUENCING AND SCHEDULING

#### 1.8.1 Concrete Surfaces

Do not start water repellent coating until all patching, pointing and cleaning operations have been completed and concrete has cured a minimum of 30 days under normal weather conditions.

#### 1.8.2 Sealants

Do not apply water repellents until the sealants for joints adjacent to surfaces receiving water repellent treatment have been installed and cured.

- a. Water repellent work may precede sealant application only if sealant adhesion and compatibility have been tested and verified using substrate, water repellent, and sealant materials identical to those used in the work.
- b. Provide manufacturers' test results of compatibility.

### 1.9 INSPECTIONS

Notify the manufacturer's representative a minimum of 72 hours prior to scheduled application of water repellents for field inspection. Inspect surfaces and obtain approval in writing from the manufacturer's representative prior to any application of any water repellent coating.

#### 1.10 SURFACES TO BE COATED

Coat all exterior concrete surfaces where exposed to view and not scheduled to receive waterproofing or other finish. This includes driveways, sidewalks, back faces of parapets, top of walls, edges and returns adjacent to windows and door frames and free standing walls. Coat all interior concrete floor slabs where exposed to view. This includes floors in garage, mechanical rooms and electrical rooms. Coat concrete surfaces concealed by raised floors.

#### 1.11 WARRANTY

Provide a warranty, issued jointly by the manufacturer and the applicator of the water repellent treatment against moisture penetration through the treated structurally sound surface for a period of five years. Warranty to provide the material, labor, and equipment necessary to remedy the problem.

At the satisfactory completion of the work, complete the warranty sign, notarize, and submit to the Contracting Officer.

## PART 2 PRODUCTS

## 2.1 MATERIALS

Water repellent solution shall be a clear, non-yellowing, deep-penetrating, VOC compliant solution. Material shall not stain or discolor and shall produce a mechanical and chemical interlocking bond with the substrate to the depth of the penetration.

## 2.2 WATER REPELLENTS

## 2.2.1 Silane, 20 Percent Solids

Penetrating water repellent. A monomeric compound containing approximately 20 percent alkyltrialkoxysilanes with alcohol, mineral spirits, water, and other proprietary solvent carrier.

- a. Composition: Modified alkylalkoxysilane.
- b. Active alkylalkoxysilane content: ASTM D 2369 20 percent by weight, plus or minus 1 percent.
- c. Appearance: White, milky liquid.
- d. Average depth of penetration: Up to 10 mm depending on substrate.
- e. VOC content: Less than 350 grams per liter.
- f. Flash point, ASTM D 3278.
- g. Specific gravity, at 25 degrees C: 0.96 to 0.98.
- h. Density: .96 to .98 kilograms per liter.

## 2.2.2 Silane, 40 Percent Solids

Penetrating water repellent. A monomeric compound containing approximately 40 percent alkyltrialkoxysilanes with alcohol, mineral spirits, or water.

- a. Composition: Modified alkylalkoxysilane.
- b. Active alkylalkoxysilane content: ASTM D 2369 40 percent by weight, plus or minus 1.5 percent.
- c. Appearance: White, milky liquid.
- d. Average depth of penetration: Up to 10 mm depending on substrate.
- e. VOC content: Less than 350 grams per liter.
- f. Flash point, ASTM D 3278.
- g. Specific gravity, at 25 degrees C: 0.94 to 0.97.
- h. Density: .94 to .97 kilograms per liter.

## 2.2.3 VOC-Complying Water Repellents

Products certified by the manufacturer that they comply with local

regulations controlling use of volatile organic compounds (VOC's).

## 2.3 PERFORMANCE CRITERIA

### 2.3.1 Silane, 20 Percent Solids

- a. Water absorption test: ASTM C 642 and ASTM E 514.
- b. Moisture vapor transmission: ASTM D 1653, 28.33 perms or 51.61 percent maximum compared to untreated surfaces.
- c. Scaling resistance: ASTM C 672, non-air-entrained concrete, zero rating, no scaling, 100 cycles treated concrete.
- d. Resistance to chloride ion penetration: AASHTO T 259 and AASHTO T 260.
- e. Water penetration and leakage through masonry, ASTM E 514 percentage reduction of leakage: 97 percent minimum.
- f. Resistance to accelerated weathering, ASTM G 53 testing 2,500 hours: No loss in repellency.
- g. Drying time under normal conditions: Four hours per 24 degrees C.

### 2.3.2 Silane, 40 Percent Solids

- a. Average depth of penetration: 10 mm depending on substrate
- b. Resistance to chloride ion penetration, AASHTO T 259 and AASHTO T 260.
- c. Water absorption test, ASTM E 514: 0.42 percent per 48 hours; 1.2 percent per 50 days.
- d. Moisture vapor transmission: ASTM D 1653, 28.33 perms or 51.61 percent maximum compared to untreated surfaces.
- e. Scaling resistance, ASTM C 672, non-air-entrained concrete: Zero rating, no scaling, 100 cycles treated concrete.
- f. Resistance to accelerated weathering, ASTM G 53. Testing 2,500 hours: No loss in repellency.
- g. Drying time under normal conditions: Four hours per 24 degrees C.

## PART 3 EXECUTION

### 3.1 EXAMINATION

Examine concrete surfaces to be treated to ensure that:

- a. All visible cracks, voids or holes have been repaired.
- b. All mortar joints in masonry are tight and sound, have not been re-set or misaligned and show no cracks or spalling.
- c. Moisture contents of walls does not exceed 15 percent when measured on an electronic moisture register, calibrated for the



appropriate substrate.

- d. Concrete surfaces are free of form release agents, curing compounds and other compounds that would prevent full penetration of the water repellent material.

Do not start water repellent treatment work until all deficiencies have been corrected, examined and found acceptable to the Contracting Officer and the water repellent treatment manufacturer. Do not apply treatment to damp, dirty, dusty or otherwise unsuitable surfaces. Comply with the manufacturer's recommendations for suitability of surface.

### 3.2 PREPARATION

#### 3.2.1 Surface Preparation

Prepare substrates in accordance with water repellent treatment manufacturer's recommendation. Clean surfaces of dust, dirt, efflorescence, alkaline, and foreign matter detrimental to proper application of water repellent treatment.

#### 3.2.2 Protection

Provide masking or protective covering for materials which could be damaged by water repellent treatment.

- a. Protect glass, glazed products, and prefinished products from contact with water repellent treatment.
- b. Protect landscape materials with breathing type drop cloths: plastic covers are not acceptable.

#### 3.2.3 Compatibility

- a. Confirm treatment compatibility with each type of joint sealer within or adjacent to surfaces receiving water repellent treatment in accordance with manufacturer's recommendations.
- b. When recommended by joint sealer manufacturer, apply treatment after application and cure of joint sealers. Coordinate treatment with joint sealers.
- c. Mask surfaces indicated to receive joint sealers which would be adversely affected by water repellent treatment where treatment must be applied prior to application of joint sealers.

### 3.3 MIXING

Mix water repellent material thoroughly in accordance with the manufacturer's recommendations. Mix, in quantities required for that days work, all containers prior to application. Mix each container the same length of time.

### 3.4 APPLICATION

In strict accordance with the manufacturers written requirements. Do not start application without the manufacturer's representative being present or his written acceptance of the surface to be treated.

### 3.4.1 Water Repellent Treatment

#### 3.4.1.1 Spray Application

Spray apply water repellent material to concrete, surfaces using low-pressure airless spray equipment in strict accordance with manufacturer's printed application, instructions, and precautions. Maintain copies at the job site. Apply flood coat in an overlapping pattern allowing approximately 200 to 250 mm rundown on the vertical surface. Maintain a wet edge at all overlaps, both vertical and horizontal. Hold gun maximum 450 mm from wall.

#### 3.4.1.2 Brush or Roller Application

Brush or roller apply water repellent material only at locations where overspray would affect adjacent materials and where not practical for spray applications.

#### 3.4.1.3 Covered Surfaces

Coat all concrete, surfaces indicated including exposed floor surfaces, back faces of parapets, tops of walls, edges and returns adjacent to window and door frames, window sills, and free-standing walls, except where waterproofing or other adhered finishes are specified.

#### 3.4.1.4 Rate of Application

Apply materials to exterior surfaces at the coverages recommended by the manufacturer and as determined from sample panel test. Increase or decrease application rates depending upon the surface texture and porosity of the substrate so as to achieve even appearance and total water repellency.

#### 3.4.1.5 Number of Coats

The sample panel test shall determine the number of coats required to achieve full coverage and protection.

#### 3.4.1.6 Appearance

If unevenness in appearance, lines of work termination or scaffold lines exist, or detectable changes from the approved sample panel occur, the Contracting Officer may require additional treatment at no additional cost to the Government. Apply any required additional treatment to a natural break off point.

### 3.5 CLEANING

Clean all runs, drips, and overspray from adjacent surfaces while the water repellent treatment is still wet in a manner recommended by the manufacturer.

### 3.6 FIELD QUALITY CONTROL

Do not remove drums containing water repellent material from the job site until completion of all water repellent treatment and until so authorized by the Contracting Officer.

#### 3.6.1 Site Inspection

Inspect treatment in progress by manufacturer's representative to verify compliance with manufacturer instructions and recommendations.

-- End of Section --

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SECTION 07220

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## SECTION 07220

ROOF INSULATION  
10/01

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A208.1 (1999) Particleboard Mat Formed Woods

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 728 (1997) Perlite Thermal Insulation Board

ASTM C 1050 (1991) Rigid Cellular  
Polystyrene-Cellulosic Fiber Composite  
Roof Insulation

ASTM C 1289 (1998) Faced Rigid Cellular  
Polyisocyanurate Thermal Insulation Board

## FACTORY MUTUAL ENGINEERING AND RESEARCH (FM)

FM P9513 (1996) Loss Prevention Data for Roofing  
Contractors

FM P7825a (1998) Approval Guide Fire Protection

FM P7825c (1998) Approval Guide Building Materials

## UNDERWRITERS LABORATORIES (UL)

UL Bld Mat Dir (1999) Building Materials Directory

## 1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

## SD-03 Product Data

Product Data: G, AE.

Describe and illustrate type of insulation including specified properties. Indicate thickness and LTTR value of proposed insulation system.

#### Application of Insulation.

Insulation manufacturer's recommendations for the application and installation of insulation.

#### Inspection.

The inspection procedure for insulation installation, prior to start of roof insulation work.

#### SD-07 Certificates

Insulation; G, AO.  
Glass Roofing Felt.

Certificate attesting that the expanded perlite or polyisocyanurate insulation contains recovered material and showing estimated percent of recovered material. Certificates of compliance for felt materials.

### 1.3 STORAGE OF MATERIALS

Insulation materials shall be stored in accordance with manufacturer's instructions. Insulation, base sheet, and felt shall be kept dry at all times, before, during, and after delivery to the site and shall be stored in an enclosed building or in a closed trailer. Wet insulation, wet base sheet or wet felt shall be permanently removed from the site. Felts shall be stacked on end one level high. Felt rolls shall be maintained at a temperature above 10 degrees C for 24 hours immediately before laying.

### 1.4 FIRE CLASSIFICATION

Insulation shall have been tested as part of a roof construction assembly of the type used in this project, and the construction shall be listed as Fire-Classified in UL Bld Mat Dir or Class I in FM P7825a.

## PART 2 PRODUCTS

### 2.1 INSULATION

Insulation shall be a standard product of the manufacturer and shall be factory marked with the manufacturer's name or trade mark, the material specification number, the R-LTTR-value at 24 degrees C, and the thickness. Minimum thickness shall be as recommended by the manufacturer. Boards shall be marked individually. The insulation manufacturing process shall not include chlorofluoro carbons (CFC) or formaldehydes. Contractor shall comply with EPA requirements in conformance with Section 01670 RECYCLED / RECOVERED MATERIALS. Insulation shall be one, or a combination of the following materials:

#### 2.1.1 Composite Board Insulation

ASTM C 1050 or ASTM C 1289 Type III, or ASTM C 1289 Type VI. Perlite, in composite board, may be replaced with ANSI A208.1 wood fiberboard, 11 mm minimum thickness, provided that the composite board meets specified physical requirements. Composite board with wood fiberboard shall conform to ASTM C 1289, Type V.

### 2.1.2 Expanded-Perlite Insulation Board

ASTM C 728.

### 2.1.3 Polyisocyanurate

ASTM C 1289, Type I, or ASTM C 1289 Type II, having minimum recovered material content of 9 percent by weight of the polyisocyanurate portion of the board.

### 2.1.4 Roof Insulation Value

Provide an LTTR value in the proposed roof insulation system of not less than 30.

## 2.2 FASTENERS

Fasteners shall be specifically designed screws and plates or spikes and plates of sufficient length to hold insulation securely in place. Fasteners shall conform to insulation manufacturer's recommendations except that holding power, when driven, shall be not less than 534 N each in steel deck. Fasteners for steel or concrete decks shall conform to FM P7825c for Class I roof deck construction, and shall be spaced to conform to FM 1-90 Windstorm Classification.

## 2.3 WOOD NAILERS

Wood nailers shall conform to Section 06100 ROUGH CARPENTRY, including preservative treatment. Edge nailers shall be not less than nominal 150 mm wide and of thickness to finish flush with the top surface of the insulation. Surface mounted nailers shall be a nominal 75 mm wide by the full thickness of the insulation.

## PART 3 EXECUTION

### 3.1 COORDINATION REQUIREMENTS

Insulation and roofing membrane shall be finished in one operation up to the line of termination at the end of each day's work. Completed sections shall be waterproofed when more than one day is required to finish the roofing. Phased construction will not be permitted.

### 3.2 ENVIRONMENTAL CONDITIONS

The temperature of the roofing materials shall be as required by the manufacturer. Air temperature shall be above 4 Degrees C and there shall be no visible ice, frost, or moisture on the roof deck when the insulation and roofing are installed.

### 3.3 SUBSTRATE PREPARATION

The substrate construction of any bay or section of the building shall be completed before insulation or vapor retarder work is begun thereon. Vents and other items penetrating the roof shall be secured in position and properly prepared for flashing. Pr

### 3.4 INSTALLATION OF WOOD NAILERS



Nailers shall be secured to steel decks as indicated. Bolt anchors shall have nuts and washers countersunk, and bolts shall be cut flush with top of nailer. Powder-actuated fasteners, sized and spaced for nailer anchorage equivalent to that specified and indicated, may not be used.

### 3.5 APPLICATION OF INSULATION

Insulation shall be laid in two or more layers. Units of insulation shall be laid in courses parallel with the roof slope. End joints shall be staggered. Insulation shall be cut to fit neatly against adjoining surfaces. Joints between insulation boards shall not exceed 6 mm. Joints in successive layers shall be staggered with respect to joints of preceding layer. Where insulation is applied over steel deck, long edge joints shall continuously bear on surfaces of the steel deck. Insulation which can be readily lifted after installation is not considered to be adequately secured. Insulation shall be applied so that all roof insulation applied each day is waterproofed the same day. Phased construction will not be permitted. Application of impermeable faced insulation shall be performed without damage to the facing.

#### 3.5.1 Mechanical Fastening

On steel decks, the insulation shall be mechanically fastened. Method of attachment shall be in accordance with recommendations of the insulation manufacturer and requirements specified.

#### 3.5.2 Steel Decks

All steel decks shall be insulated before receiving a roof membrane.

#### 3.5.3 Protection Requirements

The insulation shall be kept dry at all times. Insulation boards shall not be kicked into position. Exposed edges of the insulation shall be protected by cutoffs at the end of each work day or whenever precipitation is imminent. Cutoffs shall be per manufacturer's recommendations. Cutoffs shall be removed when work is resumed. Edges of insulation at open spaces between insulation and parapets or other walls and spaces at curbs, scuttles, and expansion joints, shall be protected until permanent roofing and flashing is applied. Storing, walking, wheeling, or trucking directly on insulation or on roofed surfaces will not be permitted. Smooth, clean board or plank walkways, runways, and platforms shall be used, as necessary to distribute weight to conform to indicated live load limits of roof construction.

### 3.6 INSPECTION

The Contractor shall establish and maintain an inspection procedure to assure compliance of the installed roof insulation with the contract requirements. Any work found not to be in compliance with the contract shall be promptly removed and replaced or corrected in an approved manner. Quality control shall include, but not be limited to, the following:

- a. Observation of environmental conditions; number and skill level of insulation workers; start and end time of work.

- b. Verification of certification, listing or label compliance with FM P9513.

- c. Verification of proper storage and handling of insulation and vapor retarder materials before, during, and after installation.
- d. Inspection of vapor retarder application, including edge envelopes and mechanical fastening.
- e. Inspection of mechanical fasteners; type, number, length, and spacing.
- f. Coordination with other materials, cants, sleepers, and nailing strips.
- g. Inspection of insulation joint orientation and laps between layers, joint width and bearing of edges of insulation on deck.
- h. Installation of cutoffs and proper joining of work on subsequent days.
- i. Continuation of complete roofing system installation to cover insulation installed same day.

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SECTION 07413

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10/01

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## SECTION 07413

COMPOSITE METAL SIDING  
10/01

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AIR MOVEMENT AND CONTROL ASSOCIATION INC (AMCA)

AMCA 511 (1991) Certified Ratings Program for Air Control Devices

AMCA 500 (1998) Test Methods for Louvers, Dampers and Shutters

## AMERICAN IRON AND STEEL INSTITUTE (AISI)

AISI SG-973 (1996) Cold-Formed Steel Design Manual

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM B 221 (2000) Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profile and Tubes

## AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE 7 (1998) Minimum Design Loads for Buildings and Other Structures

## 1.2 GENERAL REQUIREMENTS

## 1.2.1 Design

Criteria, loading combinations, and definitions shall be in accordance with ASCE 7 and TM 5-1300. Midspan deflection under maximum design loads shall be limited to L/180. Contract drawings show the design wind loads and the extent and general assembly details of the metal siding. Members and connections not shown on the drawings shall be designed by the Contractor. Siding panels and accessories shall be the products of the same manufacturer. Steel siding design shall be in accordance with AISI SG-973. Steel siding design shall be in accordance with AISI 01.

## 1.2.2 Architectural Considerations

Panel profiles shall be flush profile and corrugated profile as indicated. Match panels on existing portion of building. Existing flat panels were manufactured by Centria, Formawall Dimension Series, embossed non-directional texture, Color: Bright Silver Metallic #9710.

Existing corrugated panels were manufactured by Centria, Dimension DS-60 profile, embossed texture, Color: Bright Silver Metallic #9710.

### 1.3 COORDINATION

Installer shall coordinate composite metal siding, aluminum doors, expansion joints and frames specified in Section 08210, aluminum windows and storefront specified in Section 08420, and wall copings specified in section 07600 and expansion joints specified in Section 05811 to provide durable, integral, weather tight exterior enclosure system with consistently aligned joints and surfaces, and consistent finishes.

### 1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

#### SD-02 Shop Drawings

Siding; G, AE.

Drawings consisting of catalog cuts, design and erection drawings, shop coating and finishing specifications, and other data as necessary to clearly describe design, materials, sizes, layouts, construction details, fasteners, and erection. Drawings shall be accompanied by engineering design calculations for the siding panels.

#### SD-04 Samples

Texture and Color Samples; G, AE.

Submit six samples of minimum 76 x 125 mm size showing material and texture.

Siding; G, AE.

One piece of each type and finish (exterior and interior) to be used, 225 mm long, full width.

Gaskets and Insulating Compounds.

Two samples of each type to be used and descriptive data.

Sealant; G, AE.

One sample, approximately 0.5 kg, and descriptive data.

#### SD-07 Certificates

Siding.  
Installation.  
Accessories.

Certificates attesting that the panels and accessories conform to the requirements specified. Certified laboratory test reports

showing that the sheets to be furnished are produced under a continuing quality control program and that a representative sample consisting of not less than 5 pieces has been tested and has met the quality standards specified for factory color finish. Mill certification for structural bolts, siding, and wall liner panels.

## 1.5 DELIVERY AND STORAGE

Materials shall be delivered to the site in a dry and undamaged condition and stored out of contact with the ground. Materials shall be covered with weathertight coverings and kept dry. Storage accommodations for metal siding shall provide good air circulation and protection from surface staining.

## 1.6 WARRANTIES

The Contractor shall provide a weather tight warranty for the metal siding for a period of 20 years to include siding panel assembly, 10 years against the wear of color finish, and 10 years against the corrosion of fasteners caused by ordinary wear and tear by the elements. The warranties shall start upon final acceptance of the work or the date the Government takes possession, whichever is earlier.

## PART 2 PRODUCTS

### 2.1 FACTORY INSULATED METAL PANELS

#### 2.1.1 Flat Steel Panels

Insulated wall panels shall be factory-fabricated units with insulating core between metal face sheets, securely fastened together and uniformly separated with rigid spacers. Exterior facings shall be 22 ga. Stucco embossed steel with a G-90 zinc coating. Liner facing shall be 26 ga. steel with a G-90 zinc coating. Finish shall be PPG Duranar XL Metallic (four coat) system or approved equal. Liner panels shall have manufacturer's standard white color baked enamel finish. Height, joint width, texture and exterior color to match existing metal wall panels. Profile shall be 50 mm (2 inch) thick, and 762 mm (30 inches) high, joints to conceal fasteners, and reveals that match existing building.

#### 2.1.2 Corrugated Profile Steel Panels

Insulated wall panels shall be factory-fabricated units with insulating core between metal face sheets, securely fastened together and uniformly separated with rigid spacers. Exterior facings shall be 22 ga stucco embossed steel with a G-90 zinc coating. Liner facing shall be 26 ga. steel with a G-90 zinc coating. Liner panels shall have manufacturer's standard white color baked enamel finish. Exterior finish shall be PPG Duranar XL Metalic (four coat) system or approved equal. Exterior color to match existing metal wall panels.

#### 2.1.3 Characteristics

Insulation shall be compatible with adjoining materials; capable of retaining it R-value for the life of the metal facing sheets; and unaffected by extremes of temperature and humidity. The assembly shall have a flame spread rating not higher than 25, and smoke developed rating not higher than 450 when tested in accordance with ASTM E 84. The

insulation shall remain odorless, free from mold, and not become a source of food and shelter for insects. Panels shall be not less than 50 mm thick.

#### 2.1.4 Metal Siding

Vertical Corrugated metal wall panels, 19 mm profile, 0.91 mm thick, lap seam, exposed fasteners with neoprene gaskets. Exterior finish shall be PPG XL metallic (four coat) system or approved equal. Exterior color to match existing metal wall panels.

#### 2.2 LOUVERS

Wall louvers shall be designed to integrate with wall panel joinery. Wall louvers shall bear the AMCA certified ratings program for air performance and water penetration in accordance with AMCA 500 and AMCA 511. The rating shall show a water penetration of less than 0.06 kg per square meter of free area at a free velocity of 244 meters per minute. Louvers shall be extruded aluminum, ASTM B 221, alloy 6063, finished with minimum 70/percent polyvinylidene fluoride paint finish to match wall panels.

Furnish fully fabricated louvers to sizes indicated, complete with storm proof blades and bird screens on the interior side. Louvers shall be designed to resist the wind loads indicated. Fabricate the louver between the garage and air shaft only to have surface fasteners to permit removability from garage interior to allow occasional cleaning of air shaft.

#### 2.3 ACCESSORIES

Flashing, trim, metal closure strips, caps, and similar metal accessories shall be the manufacturer's standard or custom products. Exposed metal accessories shall be finished to match the panels furnished. Vertical joint gaskets shall be rubber or neoprene, or polyvinyl chlorided premolded to match configuration of the panels and shall not absorb or retain water. Wherever exposed to view, color of gaskets shall match color of panels.

#### 2.4 FASTENERS

Fasteners for wall panels shall be zinc-coated steel, corrosion resisting steel, type and size as recommended by manufacturer for the applicable requirements. Fasteners for accessories shall be the manufacturer's standard. Nonpenetrating fastener system for wall panels using concealed clips shall be manufacturer's standard for the system provided. Location and spacing of fasteners shall be determined by the pressures indicated.

##### 2.4.1 Bolts

Bolts shall be not less than 6 mm diameter, shouldered or plain shank as required, with proper nuts.

#### 2.5 INSULATION

Provide factory foamed-in-place insulation in exterior panels without voids. The exterior wall system shall provide a minimum R-14.

#### 2.6 SEALANT

Sealant shall be an elastomeric type containing no oil or asphalt. Exposed sealant shall be clear and shall cure to a rubberlike consistency.

## 2.7 GASKETS AND INSULATING COMPOUNDS

Gaskets and insulating compounds shall be nonabsorptive and suitable for insulating contact points of incompatible materials. Insulating compounds shall be nonrunning after drying. Vertical (visible) gaskets shall be silver-gray colored to match wall panels, horizontal (concealed) gaskets shall be black.

## PART 3 EXECUTION

### 3.1 INSTALLATION

Installation shall be in accordance with the manufacturer's erection instructions and drawings. Dissimilar materials which are not compatible when contacting each other shall be insulated from each other by means of gaskets or insulating compounds. Exposed surfaces and edges shall be kept clean and free from sealant, metal cuttings, hazardous burrs, and other foreign material. Stained, discolored, or damaged sheets shall be removed from the site.

#### 3.1.1 Siding and Accessories

##### 3.1.1.1 Concealed Fastener Wall Panels

Panels shall be fastened to framing members with concealed fastening clips or other concealed devices standard with the manufacturer. Spacing of fastening clips and fasteners shall be in accordance with the manufacturer's written instructions. Spacing of fasteners and anchor clips along the panel interlocking ribs shall be as required by design loads. Fasteners shall not puncture metal sheets except as approved for flashing, closures, and trim; exposed fasteners shall be installed in straight lines. Interlocking ribs shall be sealed with factory-applied sealant. Joints at accessories shall be sealed.

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SECTION 07530

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09/95

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## SECTION 07530

## ELASTOMERIC ROOFING (EPDM)

09/95

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 412	(1998) Test, Method for Vulcanized Rubber Elastomeric Tension
ASTM D 624	(2000) Test Method Per Tear Strength of Convention Vulcanized Rubber and Thermoplastic Elastomers
ASTM D 2240	(2002) Test Method for Rubber Property-Durometer Hardness
ASTM D 1149	(1999) Test Method for Rubber Deterioration-Surface ozone Cracking in a Camber
ASTM D 1204	(2002) Test Method for Linear Dimensional Changes of Nonrigid Thermo Plastic Sheetting or Film at Elevated Temperature
ASTM D 4637	(1996) EPDM Sheet Used in Single-Ply Roof Membrane
ASTM E 108	(1996) Fire Tests of Roof Coverings

## FACTORY MUTUAL ENGINEERING AND RESEARCH (FM)

FM P9513	(1996) Loss Prevention Data for Roofing Contractors
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## UNDERWRITERS LABORATORIES (UL)

UL 580	(1994; Rev thru Feb 1998) Tests for Uplift Resistance of Roof Assemblies
UL 790	(1997; Rev thru Jul 1998) Tests for Fire Resistance of Roof Covering Materials
UL 1256	(1998) Fire Test of Roof Deck Constructions

## 1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

#### SD-02 Shop Drawings

Roofing System; G, AE.

Drawings showing size of sheets, position of sheets and splices, flashing details, fastening patterns where applicable for insulation and membrane sheets, and expansion joint details. Detail showing construction of water cutoffs to be used at membrane terminations at the end of a day's work to seal the roofing system from water intrusion.

#### SD-03 Product Data

Installation.

Manufacturer's instructions for preparing and installing the membrane, flashings, seams, insulation, nailers and other accessories.

Protection of Finished Roofing.

Protection plan showing areas to be protected, type of material used; a plan to protect the membrane from damage until completion of work by other trades, and a description of the method of repairing the roofing.

Inspection.

The inspection procedure for substrate suitability including decks, curbs and insulation installation, prior to start of the work. Inspection procedures during and after placement of the membrane, and after completion of work by other trades.

#### SD-07 Certificates

Materials.

Certificates of compliance attesting that the roofing system and materials meet specification requirements. The certificates shall list the components required for the specified fire and wind uplift resistance ratings.

### 1.3 GENERAL REQUIREMENTS

Elastomeric membrane roofing shall be fully adhered to the roof surfaces indicated. Roofing membrane sheet widths shall be consistent with membrane attachment methods and wind uplift requirements, and shall be as large as practical to minimize joints. Membrane shall be free of defects and foreign material. Flashing work shall be coordinated to permit continuous membrane installation operations. Applied insulation shall be weatherproofed by the membrane on the same day.

#### 1.3.1 Delivery and Storage

Materials shall be delivered to the jobsite in the manufacturer's original, unopened packages, clearly marked with the manufacturer's name, brand name, and description of contents. Materials shall be stored in clean, dry areas. Storage temperatures shall be as specified by the manufacturer. Materials stored on the roof shall not exceed one day's supply and shall be distributed so as not to exceed the roof live load capacity.

#### 1.3.2 Fire Resistance

The completed roof system shall have a ASTM E 108 (same test as UL 790 and FM P9513, Appendix A) Class A classification, and meet fire test requirements of UL 1256 or FM P9513, Appendix B for roof deck construction.

Compliance of each component of the roofing system shall be evidenced by label or by written certification from the manufacturer.

#### 1.3.3 Wind Uplift Requirements

Fully adhered roofing systems shall have a 90 UL 580 Class Rating or FM P9513, Appendix C Windstorm Classification. Ratings from other independent laboratories may be substituted provided that the tests, requirements and ratings are documented to be equivalent, to the satisfaction of the Contracting Officer.

#### 1.3.4 Warranty

Manufacturer's standard warranty for the roofing system shall be provided for not less than 20 years from acceptance of the work. Warranty shall state that manufacturer shall repair or replace defective materials if the roofing system leaks or allows the insulation beneath the membrane to become wet during the period of the warranty.

Provide permanent, professionally produced sign measuring approximately 400 mm square, wall mounted near door from stair to roof stating that roof is under warranty, time period of warranty, roof installers name and telephone number, and roof membrane manufacturer's name and telephone number.

### PART 2 PRODUCTS

#### 2.1 ADHESIVES

Adhesives, splicing cements, solvents, and sealants shall be as recommended by the membrane manufacturer.

#### 2.2 FASTENERS

Fasteners for sheet-metal flashing shall be corrosion resistant steel annular-type nails or screws.

#### 2.3 FLASHING

Flashing shall be of ultra-violet resistant materials as recommended by the membrane manufacturer. Prefabricated shaped flashings shall be used where possible. Sheared edges of metal flashings that contact the membrane shall be turned into a tight hem.

EPDM flashing shall lap over the top of the perimeter blocking and extend up the parapet wall and turn over the top of the parapet and beneath the prefinished metal coping and extend down the face of the wall a minimum of

two inches. The two inches of EPDM on the face of the wall shall be completely covered by the prefinished coping. The EPDM shall be fully adhered to the parapet wall.

## 2.4 MEMBRANE

Membrane shall conform to ASTM D 4637, Type I EPDM, Grade 1; Class U, 1.52 mm minimum thickness.

## 2.5 PREFABRICATED ACCESSORIES

Pipe seals shall be types and sizes recommended by the membrane manufacturer. Expansion joints shall be as specified in Section 05811 ARCHITECTURAL JOINT SYSTEMS.

## 2.6 WALKWAYS

Provide 762 x 762 x 8 mm thick (30 x 30 inches x 0.3 inches high) molded black rubber walkway pads.

## 2.7 MEMBRANE PROTECTON LAYER

Adhere 1.5 mm thick sheet of self-curing neoprene over EPDM at locations indicated. Provide neoprene with the following minimum properties:

Tensile Strength	10.3 MPa	Per ASTM D 412
Elongation	250 Percent	Per ASTM D 412
Tear Strength	26.3 kN/m	Per ASTM D 624
Shore A Durometer	65+/- 10	Per ASTM D 2240

Ozone Resistance at 37.8 degrees C with 50 percent extension no cracks per ASTM D 1149

Brittleness Temperature -35 degrees C per ASTM D 746

Heat aging after 70 hours exposure at 100 degrees C:

Tensile Strength	9 MPa	Per ASTM D 412
Elongation	150 Percent	Per ASTM D 412
Tear Strength	21.9 kN/m	Per ASTM D 624
Linear Dimension Change	+/- 3 percent	Per ASTM D 1204

## PART 3 EXECUTION

### 3.1 ENVIRONMENTAL CONDITIONS

Membrane shall not be installed in high wind, inclement weather or when there is visible ice, frost or moisture on the deck, insulation or membrane. Membrane shall not be installed when air temperature is below the minimum specified by the membrane manufacturer.

### 3.2 PREPARATION

The substrate of any bay or section of the building shall be complete and suitable for insulation and membrane installation before roofing is begun. Insulation over which elastomeric roofing is installed shall conform to Section 07220 ROOF INSULATION. Surfaces against which membrane is applied shall be smooth, clean, and free from dirt, water, dew, oil, grease, sharp edges and construction debris; all joints over 6 mm wide shall be sealed;

joints over 13 mm between insulation boards shall be filled with the same insulation. Wood nailers shall comply with Section 06100 ROUGH CARPENTRY.

### 3.3 INSTALLATION

Installation shall comply with the manufacturer's approved instructions, except as otherwise specified.

#### 3.3.1 Flashing

Edges of membrane, projections through the roof and changes in roof planes shall be flashed. The flashing material shall be extended and sealed a minimum of 75 mm on each side of the fasteners which attach the membrane to nailers. The installed flashing shall be fastened at the top of the flashing a maximum of 300 mm on center under metal counter-flashing or cap.

#### 3.3.2 Expansion Joints

Expansion joints shall be covered using prefabricated covers or elastomeric flashing in accordance with the manufacturer's recommendations.

#### 3.3.3 Membrane Installation

Membrane shall be applied in accordance with the manufacturer's instructions and the following requirements. Adjoining sheets comprising the membrane shall be adhered one to another using a butyl-based contact adhesive. Minimum width of the laps shall be 75 mm. A primer shall be used before applying the contact adhesive if required by the membrane manufacturer. In applying the contact adhesive, the minimum thickness of the wet film shall be in accordance with the membrane manufacturer's recommendations. If manufacturer's recommendations are not available, the minimum thickness shall be 0.6 mm. A wet film thickness gage shall be used to determine wet film thickness. Direction of lap shall be such that water flows over lap. Membrane joints shall be free of wrinkles or fishmouths. Before application of the contact adhesive, the rubber surfaces to be mated shall be well cleaned. Joints shall be inspected over entire length after completion and defective areas shall be resealed and patched. Damaged areas of membrane shall be removed and replaced with new materials, lapping underlying membrane by at least 75 mm on all sides.

#### 3.3.4 Cutoffs

Cutoffs shall be installed if work day is ended or interrupted by bad weather before roof section is complete. The insulation line shall be straightened using loose-laid cut insulation and the membrane shall be sealed to the roof deck. Flutes in metal decking shall be sealed off along the cutoff edge. Membrane shall be pulled free or cut to expose the insulation when resuming work, and cut insulation sheets used for fill-in shall be removed as necessary to maintain the staggered pattern.

#### 3.3.5 Membrane Protection Layer

Adhere membrane protection layer over membrane in area of kitchen hood exhaust as recommended by manufacturer.

#### 3.3.6 Installation of Walkways

Adhere walkway pads to roof membrane in accordance with manufacturer's instructions. Provide 25 to 75 mm space between each pad.

### 3.4 PROTECTION OF FINISHED ROOFING

The roofing membrane shall be protected from damage by other trades. After completion of work by other trades, the protection shall be removed and the roof shall be inspected. Any damage shall be repaired in accordance with the recommendations of the roofing manufacturer.

### 3.5 INSPECTION

The Contractor shall establish and maintain an inspection procedure to assure compliance of the installed elastomeric roofing with the contract requirements. The procedure shall include a checklist of points to be observed. Any work found not to be in compliance with the contract shall be promptly removed and replaced or corrected in an approved manner. Quality control shall include, but not be limited to, the following:

- a. Observation of environmental conditions; number and skill level of roofing workers; start and end time of various tasks; condition of substrate.
- b. Verification of compliance of materials before, during and after installation.
- c. Inspection of insulation, nailers, flashings, penetrations and work requiring coordination with roofing.
- d. Inspection of membrane placement, splicing, and attachment.
- e. Inspection of placement of walkways.

-- End of Section --

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## SECTION 07600

## SHEET METALWORK, GENERAL

11/01

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 167	(1999) Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM B 209M	(2000) Aluminum and Aluminum-Alloy Sheet and Plate (Metric)
ASTM B 221M	(2000) Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric)
ASTM B 32	(1996) Solder Metal
ASTM D 226	(1997a) Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing

## SHEET METAL &amp; AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)

SMACNA Arch. Manual	(1993; Errata; Addenda Oct 1997) Architectural Sheet Metal Manual
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## 1.2 GENERAL REQUIREMENTS

Sheet metalwork shall be accomplished to form weathertight construction without waves, warps, buckles, fastening stresses or distortion, and shall allow for expansion and contraction. Cutting, fitting, drilling, and other operations in connection with sheet metal required to accommodate the work of other trades shall be performed by sheet metal mechanics. Installation of sheet metal items used in conjunction with roofing shall be coordinated with roofing work to permit continuous roofing operations. Sheet metalwork pertaining to heating, ventilating, and air conditioning is specified in Section 15895 AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEM.

## 1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

## SD-02 Shop Drawings

Materials; G, AE.

Drawings of sheet metal items showing weights, gauges or thicknesses; types of materials; expansion-joint spacing; fabrication details; and installation procedures.

## 1.4 DELIVERY, STORAGE, AND HANDLING

Materials shall be adequately packaged and protected during shipment and shall be inspected for damage, dampness, and wet-storage stains upon delivery to the jobsite. Materials shall be clearly labeled as to type and manufacturer. Sheet metal items shall be carefully handled to avoid damage. Materials shall be stored in dry, ventilated areas until immediately before installation.

## 1.5 COORDINATION

Coordinate design, installation, and finish of wall copings with installer of wall cladding specified in Section 07413 COMPOSITE METAL SIDING. Coordinate, design, installation, and finish of counter flashing installation with roofing specified in Section 07530 and with waterproofing specified in Section 07132.

## PART 2 PRODUCTS

## 2.1 MATERIALS

Lead, lead-coated metal and copper shall not be used. Any metal listed by SMACNA Arch. Manual for a particular item may be used, unless otherwise specified or indicated. Materials shall conform to the requirements specified below and to the thicknesses and configurations established in SMACNA Arch. Manual. Different items need not be of the same metal. All metal shall be prefinished. Aluminum exposed to view shall be anodized. Galvanized steel shall be finished with 70-percent polyfluorovinylidene color coating to match wall system.

## 2.1.1 Accessories

Accessories and other items essential to complete the sheet metal installation, though not specifically indicated or specified, shall be provided.

## 2.1.2 Aluminum Extrusions

ASTM B 221M , Alloy 6063, Temper T5.

## 2.1.3 Sealant

Unless otherwise specified, sealant shall be an elastomeric weather resistant sealant as specified in Section 07900 JOINT SEALING.

## 2.1.4 Fasteners

Fasteners shall be compatible with the fastened material and shall be the type best suited for the application.

### 2.1.5 Felt

ASTM D 226, Type I.

### 2.1.6 Aluminum Alloy Sheet and Plate

ASTM B 209M , anodized clear , form, alloy, and temper appropriate for use.

### 2.1.7 Stainless Steel

ASTM A 167, Type 302 or 304; fully annealed, dead soft temper.

### 2.1.8 Solder

ASTM B 32, 95-5 tin-antimony.

## PART 3 EXECUTION

### 3.1 GENERAL REQUIREMENTS

Gutters and downspouts shall be designed and fabricated in conformance with SMACNA Arch. Manual. Unless otherwise specified or indicated, exposed edges shall be folded back to form a 13 mm (1/2 inch) hem on the concealed side, and bottom edges of exposed vertical surfaces shall be angled to form drips. Bituminous cement shall not be placed in contact with roofing membranes.

### 3.2 EXPANSION JOINTS

Expansion joints shall be provided as specified in SMACNA Arch. Manual. Expansion joints in continuous sheet metal shall be provided at 9.6 meter intervals for aluminum, except extruded aluminum gravel stops and fasciae which shall have expansion joints at not more than 3.6 meter spacing. Joints shall be evenly spaced. An additional joint shall be provided where the distance between the last expansion joint and the end of the continuous run is more than half the required interval spacing.

### 3.3 PROTECTION OF ALUMINUM

Aluminum shall not be used where it will be in contact with copper or where it will contact water which flows over copper surfaces. Aluminum that will be in contact with wet or pressure-treated wood, mortar, concrete, masonry, or ferrous metals shall be protected against galvanic or corrosive action by one of the following methods:

#### 3.3.1 Paint

Mill-finish aluminum surfaces shall be solvent cleaned and given one coat of direct-to-metal acrylic primer and one coat of aluminum paint as specified in Section 09900 PAINTING, GENERAL. Do not paint anodized aluminum.

#### 3.3.2 Nonabsorptive Tape or Gasket

Nonabsorptive tape or gasket shall be placed between the adjoining surfaces and cemented to the aluminum surface using a cement compatible with aluminum.

### 3.4 CONNECTIONS AND JOINTING

### 3.4.1 Soldering

Soldering shall apply to stainless steel items. Edges of sheet metal shall be pretinned before soldering is begun. Soldering shall be done slowly with well heated soldering irons so as to thoroughly heat the seams and completely sweat the solder through the full width of the seam. Edges of stainless steel to be pretinned shall be treated with soldering acid flux. Soldering shall follow immediately after application of the flux. Upon completion of soldering, the acid flux residue shall be thoroughly cleaned from the sheet metal with a water solution of washing soda and rinsed with clean water.

### 3.4.2 Riveting

Joints in aluminum sheets 1.0 mm or less in thickness shall be mechanically made.

### 3.4.3 Seaming

Flat-lock and soldered-lap seams shall finish not less than 25 mm wide. Unsoldered plain-lap seams shall lap not less than 75 mm unless otherwise specified. Flat seams shall be made in the direction of the flow.

## 3.5 CLEATS

A continuous cleat shall be provided where indicated or specified to secure loose edges of the sheet metalwork. Butt joints of cleats shall be spaced approximately 3 mm apart. The cleat shall be fastened to supporting wood construction with nails evenly spaced not over 300 mm on centers. Where the fastening is to be made to concrete or masonry, screws shall be used and shall be driven in expansion shields set in concrete or masonry.

## 3.6 GUTTERS AND DOWNSPOUTS

Gutters and downspouts shall be installed as indicated. Gutters shall be supported by continuous cleats or by cleats spaced not less than 915 mm (36 inches) apart. Downspouts shall be rigidly attached to the building. Supports for downspouts shall be spaced according to manufacturer's recommendations.

## 3.7 FLASHINGS

Flashings shall be installed at locations indicated and as specified below. Sealing shall be according to the flashing manufacturer's recommendations. Flashings shall be installed at intersections of roof with vertical surfaces and at projections through roof, except that flashing for heating and plumbing, including piping, roof, and floor drains, and for electrical conduit projections through roof or walls are specified in other sections. Except as otherwise indicated, counter flashings shall be provided over base flashings.

### 3.7.1 Counter Flashings

Except as otherwise indicated, counter flashings shall be provided over base flashings. Counter flashing shall be installed as shown on the drawings or in SMACNA Arch. Manual. Counter flashing shall be factory formed to provide spring action against the base flashing.

### 3.8 CONTRACTOR QUALITY CONTROL

The Contractor shall establish and maintain a quality control procedure for sheet metal to assure compliance of the installed sheet metalwork with the contract requirements. Any work found not to be in compliance with the contract shall be promptly removed and replaced or corrected in an approved manner. Quality control shall include, but not be limited to, the following:

- a. Observation of environmental conditions; number and skill level of sheet metal workers; condition of substrate.
- b. Verification of compliance of materials before, during, and after installation.
- c. Inspection of sheet metalwork for proper size and thickness, fastening and joining, and proper installation.

The actual quality control observations and inspections shall be documented and a copy of the documentation furnished to the Contracting Officer at the end of each day.

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SECTION 07721

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## SECTION 07721

## MANUFACTURED CURBS

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

## AMERICAN SOCIETY for TESTING and MATERIALS (ASTM)

ASTM A 53 (2000) Sheet Steel, Zinc-Coated  
(Galvanized) or Zinc-Iron Alloy-Coated  
(Galvanealed) by the Hot-Dip Process

## 1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

## SD-02 Shop Drawings

Shop Drawings; G, AE.

Dimensioned drawings showing overall layout details, jointing, connections, and fasteners. Show adjacent construction including roof deck, roofing system, and equipment. Include manufacturer's product data.

Provide Overlay Coordination Drawing. Showing interface between Architectural, Structural, Mechanical, and Electrical Drawings with applicable roof curbs.

## SD-05 Design Data

Structural Calculations

Signed and sealed by registered professional engineer.

## SD-08 Manufacturer's Instructions

Installation

Include installation instructions, rough-in dimensions, special procedures, and perimeter conditions requiring special attention.

## 1.3 QUALITY ASSURANCE

## 1.3.1 Manufacturer



1. Design, fabricate, and furnish roof curbs and equipment supports to accurate dimensions, configuration, and structural rigidity to meet requirements for watertight systems.
2. Accommodate loading capacity and connections of roof equipment, configuration of and watertight connections to roofing system, and configuration and spanning capacity between structural members at openings in roof deck.

#### 1.4 QUALIFICATIONS

##### 1.4.1 Manufacturer

1. Able to document minimum 10 years continuous experience designing, manufacturing, and supplying work of this Section.
2. Maintain engineering and design capabilities to furnish customized curbs, expansion joints, and equipment supports.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

Deliver on pallets or protective packaging with manufacturer's identifying labels legible and intact.

Store on pallets above water, mud, and dirt, protected from soiling and damage.

Handle to prevent permanent warping and racking of frame.

#### 1.6 WARRANTY

##### 1.6.1 Manufacturer

Standard 5 year limited Warranty against defects in labor and workmanship.

## PART 2 PRODUCTS

### 2.1 ROOF CURBS AND EQUIPMENT SUPPORTS

#### 2.1.1 Frames

1. Material: ASTM A 53 G90 hot-dipped galvanized steel.
  - a. Minimum 18 gauge, and as engineered by manufacturer.
  - b. Minimum 14 gauge for curbs supporting HVAC units
  - c. Minimum 20 gauge for expansion joint curbs.
2. Corners: Mitered and welded (welds are micro sealed and prime painted after fabrication). Bolted connections not accepted.
3. Base Plates: Integral to frame and welded.
4. Internally reinforced with galvanized 25 mm by 25 mm by 12 gauge angles for curbs exceeding 915 mm length. Reinforce internal bulkhead at equipment curbs to support lateral loads.
5. Wood Nailers: Factory installed, pressure treated. Size and width as suitable for support of items installed on curbs.

### 2.1.2 Insulation

Factory installed 38 mm thick three-pound density fiberglass insulation.

### 2.1.3 Curb Height

Minimum 200 mm above finished roof.

### 2.1.4 Construct Curbs

To match roof slope with plumb and level top surface for mounting mechanical equipment.

### 2.1.5 Gasketing

6 mm thick, 25 mm wide at roof top units and skylights.

### 2.1.6 Counter Flashing

18 gauge galvanized steel.

### 2.1.7 Expansion Joint Curbs

Fabricate in maximum 3 meter lengths with fully mitered and welded corners at intersections and sloping end sections, except as otherwise accepted by Contracting Officer's Representative.

Provide splice plates and connector clips.

### 2.1.8 Fabrication

Fabricate platforms, adapters, pipe curbs, curb covers, square to round, column and tube counterflashings as necessary for complete watertight systems at roof penetrations.

## PART 3 EXECUTION

### 3.1 EXAMINATION

Verify conditions ready to receive work of this Section. Do not proceed until unsatisfactory conditions are corrected. Beginning work constitutes acceptance of existing conditions.

### 3.2 INSTALLATION

Install in accordance with manufacturer's instructions.

Weld, bolt, or screw fasten roof curbs and expansion joint curbs as instructed by manufacturer, as shown on accepted shop drawings, and as approved by Contracting Officer.

Equipment Supports: Span minimum two structural members.

Do not apply load to cantilever exceeding 600 mm length, for equipment supports.

Do not apply load to cantilever exceeding 1,200 mm lengths for roof curbs.

### 3.3 ADJUSTING

Replace or repair installations not conforming to specified requirements including installations out of level and out of plumb.

#### 3.4 CLEANING

Leave installation clean, free of debris and residue resulting from work of this Section.

-- End of Section --

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## DIVISION 07 - THERMAL &amp; MOISTURE PROTECTION

## SECTION 07810

## SPRAY-APPLIED AND DUCT WRAP FIREPROOFING

**08/02**

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## SECTION 07810

SPRAY-APPLIED AND DUCT WRAP FIREPROOFING  
08/02

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by basic designation only.

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM E 1042	(1992; R 1997el) Acoustically Absorptive Materials Applied by Trowel or Spray
ASTM E 119	(2000) Fire Tests of Building Construction and Materials
ASTM E 605	(1993; R 1996) Thickness and Density of Sprayed Fire-Resistive Material (SFRM) Applied to Structural Members
ASTM E 736	(1992) Cohesion/Adhesion of Sprayed Fire-Resistive Materials Applied to Structural Members
ASTM E 759	(1992; R 1996) Effect of Deflection on Sprayed Fire-Resistive Material Applied to Structural Members
ASTM E 760	(1992; R 1996el) Effect of Impact on Bonding of Sprayed Fire-Resistive Material Applied to Structural Members
ASTM E 761	(1992) Compressive Strength of Sprayed Fire-Resistive Material Applied to Structural Members
ASTM E 84	(2000a) Surface Burning Characteristics of Building Materials
ASTM E 859	(1993) Air Erosion of Sprayed Fire-Resistive Materials (SFRMS) Applied to Structural Members
ASTM E 937	(1993) Corrosion of Steel by Sprayed Fire-Resistive Material (SFRM) Applied to Structural Members
ASTM G 21	(1996) Determining Resistance of Synthetic Polymeric Materials to Fungi

## UNDERWRITERS LABORATORIES (UL)

UL 263 (1997; Rev thru Jun 1998) Fire Tests of Building Construction and Materials

UL Fire Resist Dir (1999) Fire Resistance Directory (2 Vol.)

## 1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

### SD-03 Product Data

Fireproofing Material; G, AE.

Data identifying performance characteristics of fireproofing material. Data shall include recommended application requirements and indicate thickness of fireproofing that must be applied to achieve each required fire rating.

### SD-06 Test Reports

Fire Resistance Rating; G, AE.

Reports and test records, attesting that the fireproofing material conforms to the specified requirements. Each test report shall conform to the report requirements specified by the test method.

### SD-07 Certificates

Installer Qualifications; G, RE.

Manufacturer's certification that each listed installer is qualified and trained to install the specified fireproofing. Evidence that each fireproofing installer has had a minimum of 3 years experience in installing the specified type of fireproofing.

Surface Preparation Report; G, RE.

Manufacturer's certification that surfaces to be protected have been inspected and are acceptable to receive spray-applied fireproofing. The statement shall list the structural members and the areas that have been inspected and certified.

## 1.3 DELIVERY AND STORAGE

Packaged material shall be delivered in the original unopened containers, marked to show the brand name, the manufacturer, and the UL markings. Fireproofing material shall be kept dry until ready to be used, and shall be stored off the ground, under cover and away from damp surfaces. Damaged or opened containers will be rejected. Material with shelf-life shall be applied prior to expiration of the shelf-life.

## 1.4 ENVIRONMENTAL CONDITIONS

#### 1.4.1 Temperature

Substrate and ambient air temperatures shall be maintained above 4 degrees C during application and for 24 hours before and after application. Relative humidity shall be maintained within the limits recommended by the fireproofing manufacturer.

#### 1.4.2 Ventilation

Adequate ventilation shall be provided to properly dry the fireproofing after application. In enclosed areas, a minimum of 4 air exchanges per hour shall be provided by forced air circulation.

#### 1.5 INSTALLER QUALIFICATIONS

Engage an experienced installer that is certified, licensed, or otherwise qualified by the spray-on fireproofing manufacturer as having the necessary experience, staff, and training to install the manufacturer's products in accordance with specified requirements. Each installer of fireproofing material shall be trained, have a minimum of 3 years experience and a minimum of three installations using fireproofing of the type specified. A manufacturer's willingness to sell its products to the Contractor or installer does not infer qualification of the buyer.

#### 1.6 MANUFACTURER'S SERVICES

The manufacturer or its representative shall be onsite prior to, periodically during, and at completion of the application, to provide the specified inspections and certifications; and to ensure that preparations are adequate and that the material is applied according to manufacturer's recommendations and the contract requirements.

#### 1.7 FIRE RESISTANCE RATING

Fire resistance ratings shall be in accordance with the fire rated assemblies listed in UL Fire Resist Dir. Proposed materials not listed in UL Fire Resist Dir shall have fire resistance ratings at least equal to the UL Fire Resist Dir ratings as determined by an approved independent testing laboratory, based on tests specified in UL 263 or ASTM E 119. Fireproofing shall be applied to structural steel members, with the following hourly fire resistance rating and in accordance with the following UL design or approved equivalent. Use unrestrained fire resistance ratings, unless the architect/engineer has specified that the degree of thermal restraint of the construction meets or exceeds the degree of thermal restraint of the tested assembly. Performance tests shall be in accordance with ASTM E 119.

<u>Element</u>	<u>Fire Rating Schedule</u>	
	<u>Hourly Rating</u>	<u>UL Design Reference</u>
Floor decks	1-Hour	D832
Floor supports	1-Hour	D832

#### 1.8 EXTENT OF FIREPROOFING

Where indicated on drawings, all structural steel, and undersides of steel



floors shall be protected with spray-applied fireproofing to a fire resistance hour-rating as indicated in the preceding paragraph, unless otherwise indicated.

#### 1.9 PRE-INSTALLATION CONFERENCE

The Contractor shall hold a meeting with the installer, field testing agency, the manufacturer, subcontractors (whose employees come into contact with the fireproofing), and the Contracting Officer prior to the installation of any fireproofing material to review the substrates for acceptability, method of application, applied thickness, patching, repair, inspection and testing procedures.

### PART 2 PRODUCTS

#### 2.1 SPRAY-APPLIED FIREPROOFING

Spray-applied fireproofing material, including sealer, shall conform to ASTM E 1042, Class (a), Category A, either Type I or Type II, except that the dust removed shall not exceed 0.027 gram per square meter of fireproofing material applied as specified in the project. Material shall be asbestos free, and shall resist fungus for a period of 28 days when tested in accordance with ASTM G 21. Material shall have a flame spread of 25 or less and a smoke developed rating of 50 or less when tested in accordance with ASTM E 84.

##### 2.1.1 Dry Density and Cohesion/Adhesion

Fireproofing shall have a minimum ASTM E 605 dry density of 256 kg/m<sup>3</sup> (16 PCF) and ASTM E 736 cohesion/adhesion strength of 17.2 kPa (360 PSF)

##### 2.1.2 Deflection

Spray-applied fireproofing shall not crack, spall, or delaminate when backing to which it is applied is subject to downward deflection 1/120 of 3 m clear span, when tested in accordance with ASTM E 759.

##### 2.1.3 Bond-Impact

Spray-applied fireproofing material shall not crack, spall or delaminate when tested in accordance with ASTM E 760.

##### 2.1.4 Compressive Strength

The minimum compressive strength shall be 48 kPa when tested in accordance with ASTM E 761.

##### 2.1.5 Corrosion

Spray-applied fireproofing material shall not contribute to corrosion of test panels when tested as specified in ASTM E 937.

##### 2.1.6 Air Erosion

Dust removal shall not exceed 0.25 gram per square meter when tested in accordance with ASTM E 859.

#### 2.2 WATER

Water used for material mixing and surface preparation shall be potable.

## 2.3 DUCT WRAP FIREPROOFING

Semi-rigid, 64 mm thick, 120 kg per cm, foil-faced, semi-rigid, mineral fiber, fire-rated duct insulation. Provide USG Therma Fiber, 3-M Fire Master, or equal.

## PART 3 EXECUTION

### 3.1 SURFACE PREPARATION

Surfaces to be fireproofed shall be thoroughly cleaned of dirt, grease, oil, paint, primers, loose rust, rolling lubricant, mill scale or other contaminants that will interfere with the proper bonding of the sprayed fireproofing to the substrate. Painted/primed steel substrates shall be tested in accordance with ASTM E 736, with specified sprayed fireproofing material, to provide the required fire-resistance rating; painted or primed steel surfaces may require a fireproofing bond test to determine if the paint formulation will impair proper adhesion. The Contractor shall certify the acceptability of surfaces to receive sprayed-applied fireproofing and submit a Surface Preparation Report accordingly. Overhead areas to be fireproofed shall be cleared of all obstructions interfering with the uniform application of the spray-applied fireproofing. Hardware such as support sleeves, inserts, clips, hanger attachment devices and the like shall be installed prior to the application of the fireproofing. Condition of the surfaces shall be acceptable to the manufacturer prior to application of spray-applied fireproofing. Applications listed for use on primed surfaces shall be in accordance with the manufacturer's recommendations and standards, and detailed in submittal item SD-03 Product Data.

### 3.2 PROTECTION

Surfaces not to receive spray-applied fireproofing shall be covered to prevent contamination by splatter, rebound and overspray. Exterior openings in areas to receive spray-applied fireproofing shall be covered prior to and during application of fireproofing with tarpaulins or other approved material. Surfaces not to receive fireproofing shall be cleaned of fireproofing and sealer.

### 3.3 MIXING

Fireproofing material shall be mixed in accordance with the manufacturer's recommendations.

### 3.4 APPLICATION-SPRAY-APPLIED FIREPROOFING

#### 3.4.1 Sequence

Prior to application of fireproofing on each floor, the manufacturer shall inspect and approve application equipment, water supply and pressure, and the application procedures. If fireproofing is required to be applied to underside of steel roof deck and steel floor assemblies, it shall be done only after respective roof or floor construction is complete. No roof or floor traffic shall be allowed during application and during a 7-day minimum curing period. Fireproofing material shall be applied prior to the installation of ductwork, piping and conduits which would interfere with uniform application of the fireproofing.

### 3.4.2 Application Technique

Water pressure and volume shall be maintained to manufacturer's recommendations throughout the fireproofing application. Fireproofing material shall be applied to the thickness and density established for the specified fire resistance rating, in accordance with the procedure recommended by the manufacturer, and to a uniform density and texture. Fireproofing material shall not be tamped to achieve the desired density.

### 3.4.3 Sealer Application

If sealer is required by the product used, it shall be applied after field testing has been conducted and after corrective measures and repairs, if required, have been completed.

### 3.4.4 Applied Thickness

The minimum average thickness shall be no less than 9.525 mm. Thicknesses shall not be less than required to achieve designated fire resistance ratings. If the specified thickness is greater than or equal to 25 mm, any individual measurement shall not be less than the specified thickness minus 6 mm. If the specified thickness is less than 25 mm, any individual measurement shall not be less than the specified thickness minus 25 percent.

## 3.5 FIELD TESTS

### 3.5.1 Structural Components

Thickness of each structural component type shall be measured at floor and roof decks, beams and joists. Minimum average thickness shall be as required by UL Fire Resist Dir. Density and cohesion/adhesion shall be as specified.

### 3.5.2 Repair

Additional fireproofing material may be added to provide proper thickness. Rejected areas of fireproofing shall be corrected to meet specified requirements by adding fireproofing material to provide the proper thickness, or by removing defects and respraying with new fireproofing material. Repairs shall use same type of fireproofing material as originally applied or patching materials recommended by the manufacturer. Repaired areas shall be retested and reinspected. Fireproofing material shall be applied to voids or damaged areas by hand-trowel, or by respraying.

### 3.5.3 Visual Inspections

Inspections shall be made by the certified independent laboratory prior to closure of concealed areas. These inspections may be phased, but shall not occur less than 5 working days prior to the enclosure of the fireproofing. Sprayed areas shall receive a final inspection. Fireproofed surfaces shall be inspected after mechanical, electrical, and other work in contact with fireproofing material has been completed and before sprayed material is covered. Any locations missing fireproofing shall be patched in accordance with the manufacturer's requirements.

### 3.5.4 Patching

Patching and repairing of damaged fireproofing is the responsibility of the

Contractor. The patching material shall be the same as that specified for that area.

### 3.6 CLEANUP

Surfaces not indicated to receive fireproofing shall be thoroughly cleaned of sprayed material within a 24 hour period after application.

### 3.7 APPLICATION - DUCT WRAP FIREPROOFING

Apply and fasten insulation to surfaces of duct and seal joints in insulation as recommended by manufacturer to provide a 2-hour fire rating. Smoke seal joints at wall penetrations and roof penetration in conformance with specification Section 07840 FIRESTOPPING.

-- End of Section --

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SECTION 07840

FIRESTOPPING

**08/00**

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## SECTION 07840

## FIRESTOPPING

08/00

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM E 119	(1998) Fire Tests of Building Construction and Materials
ASTM E 814	(1997) Fire Tests of Through-Penetration Fire Stops
ASTM E 1399	(1997) Cyclic Movement and Measuring the Minimum and Maximum Joint Widths of Architectural Joint Systems

## NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 101	(2000) Life Safety Code
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## UNDERWRITERS LABORATORIES (UL)

UL 1479	(1994; Rev thru Feb 1998) Fire Tests of Through-Penetration Firestops
UL 2079	(1998) Tests for Fire Resistance of Building Joint Systems
UL Fire Resist Dir	(1999) Fire Resistance Directory (2 Vol.)

## 1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

## SD-02 Shop Drawings

Firestopping Materials; G, AE..

Detail drawings including manufacturer's descriptive data, typical details conforming to UL Fire Resist Dir or other details certified by another nationally recognized testing laboratory,

installation instructions or UL listing details for a firestopping assembly in lieu of fire-test data or report. For those firestop applications for which no UL tested system is available through a manufacturer, a manufacturer's engineering judgement, derived from similar UL system designs or other tests, shall be submitted for review and approval prior to installation. Submittal shall indicate the firestopping material to be provided for each type of application. When more than 5 penetrations or construction joints are to receive firestopping, drawings shall indicate location and type of application.

#### SD-07 Certificates

Firestopping Materials; G, AE.

Certificates attesting that firestopping material complies with the specified requirements. In lieu of certificates, drawings showing UL classified materials as part of a tested assembly may be provided. Drawings showing evidence of testing by an alternate nationally recognized independent laboratory may be substituted.

Installer Qualifications; G, AO.

Documentation of training and experience.

Inspection; G, AO.

Manufacturer's representative certification stating that firestopping work has been inspected and found to be applied according to the manufacturer's recommendations and the specified requirements.

### 1.3 GENERAL REQUIREMENTS

Firestopping shall consist of furnishing and installing tested and listed firestop systems, combination of materials, or devices to form an effective barrier against the spread of flame, smoke and gases, and maintain the integrity of fire resistance rated walls, partitions, floors, and ceiling-floor assemblies, including through-penetrations and construction joints and gaps. Through-penetrations include the annular space around pipes, tubes, conduit, wires, cables and vents. Construction joints include those used to accommodate expansion, contraction, wind, or seismic movement; firestopping material shall not interfere with the required movement of the joint. Gaps requiring firestopping include gaps between the curtain wall and the floor slab and between the top of the fire-rated walls and the roof or floor deck above.

Smoke Sealing shall consist of filling the spaces of all opening in smoke barrier walls and all floors to prevent the transfer of smoke.

### 1.4 STORAGE AND DELIVERY

Materials shall be delivered in the original unopened packages or containers showing name of the manufacturer and the brand name. Materials shall be stored off the ground and shall be protected from damage and exposure to elements. Damaged or deteriorated materials shall be removed from the site.

### 1.5 INSTALLER QUALIFICATIONS

The Contractor shall engage an experienced Installer who is certified, licensed, or otherwise qualified by the firestopping manufacturer as having the necessary staff, training, and a minimum of 3 years experience in the installation of manufacturer's products per specified requirements. A manufacturer's willingness to sell its firestopping products to the Contractor or to an installer engaged by the Contractor does not in itself confer qualification on the buyer. The Installer shall have been trained by a direct representative of the manufacturer (not distributor or agent) in the proper selection and installation procedures.

## 1.6 COORDINATION

The specified work shall be coordinated with other trades. Firestopping materials, at penetrations of pipes and ducts, shall be applied prior to insulating, unless insulation meets requirements specified for firestopping. Firestopping materials at building joints and construction gaps shall be applied prior to completion of enclosing walls or assemblies. Cast-in-place firestop devices shall be located and installed in place before concrete placement. Pipe, conduit or cable bundles shall be installed through cast-in-place device after concrete placement but before area is concealed or made inaccessible.

## PART 2 PRODUCTS

### 2.1 FIRESTOPPING MATERIALS

Firestopping materials shall consist of commercially manufactured, asbestos-free products complying with the following minimum requirements:

#### 2.1.1 Fire Hazard Classification

Material shall have a flame spread of 25 or less, and a smoke developed rating of 50 or less, when tested in accordance with ASTM E 84 or UL 723. Material shall be an approved firestopping material as listed in UL Fire Resist Dir or by a nationally recognized testing laboratory.

#### 2.1.2 Toxicity

Material shall be nontoxic to humans at all stages of application.

#### 2.1.3 Fire Resistance Rating

Firestopping will not be required to have a greater fire resistance rating than that of the assembly in which it is being placed.

##### 2.1.3.1 Through-Penetrations

Firestopping materials for through-penetrations, as described in paragraph GENERAL REQUIREMENTS, shall provide "F" and "T" fire resistance ratings in accordance with ASTM E 814 or UL 1479. Fire resistance ratings shall be as follows:

- a. Penetrations of Fire Resistance Rated Walls and Partitions: F Rating = Rating of wall or partition being penetrated.

##### 2.1.3.2 Construction Joints and Gaps

Fire resistance ratings of construction joints, as described in paragraph



GENERAL REQUIREMENTS, and gaps such as those between floor slabs or roof decks and curtain walls shall be the same as the construction in which they occur. Construction joints and gaps shall be provided with firestopping materials and systems that have been tested per ASTM E 119 or UL 2079 to meet the required fire resistance rating. Systems installed at construction joints shall meet the cycling requirements of ASTM E 1399 or UL 2079.

## 2.2 COMMUNICATIONS CABLE TRAYS

At Locations where communications cable trays penetrate fire-rated construction, seal openings with firestop pillows. Install firestop pillows in accordance with manufacturer's instructions.

## 2.3 SMOKE SEALING

Seal all penetrations through floors and smoke-barrier walls where indicated on drawings. Seal in accordance with requirements of NFPA 101.

# PART 3 EXECUTION

## 3.1 PREPARATION

Areas to receive firestopping shall be free of dirt, grease, oil, or loose materials which may affect the fitting or fire resistance of the firestopping system. For cast-in-place firestop devices, formwork or metal deck to receive device prior to concrete placement shall be sound and capable of supporting device.

## 3.2 INSTALLATION

Firestopping material shall completely fill void spaces regardless of geometric configuration, subject to tolerance established by the manufacturer. Firestopping systems for filling floor voids 100 mm or more in any direction shall be capable of supporting the same load as the floor is designed to support or shall be protected by a permanent barrier to prevent loading or traffic in the firestopped area. Firestopping shall be installed in accordance with manufacturer's written instructions. Tested and listed firestop systems shall be provided in the following locations, except in floor slabs on grade:

- a. Penetrations of duct, conduit, tubing, cable and pipe through floors and through fire-resistance rated walls, partitions, and ceiling-floor assemblies.
- b. Penetrations of vertical shafts such as pipe chases, elevator shafts, and utility chutes.
- c. Gaps at the intersection of floor slabs and curtain walls, including inside of hollow curtain walls at the floor slab.
- d. Gaps at perimeter of fire-resistance rated walls and partitions, such as between the top of the walls and the bottom of roof decks.
- e. Construction joints in floors and fire rated walls and partitions.
- f. Other locations where required to maintain fire resistance rating of the construction.

### 3.2.1 Insulated Pipes and Ducts

Thermal insulation shall be cut and removed where pipes or ducts pass through firestopping, unless insulation meets requirements specified for firestopping. Thermal insulation shall be replaced with a material having equal thermal insulating and firestopping characteristics.

### 3.2.2 Fire Dampers

Fire dampers shall be installed and firestopped in accordance with Section 15895 AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEM.

## 3.3 INSPECTION

Firestopped areas shall not be covered or enclosed until inspection is complete and approved. A manufacturer's representative shall inspect the applications initially to ensure adequate preparations (clean surfaces suitable for application, etc.) and periodically during the work to assure that the completed work has been accomplished according to the manufacturer's written instructions and the specified requirements.

-- End of Section --

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## DIVISION 07 - THERMAL &amp; MOISTURE PROTECTION

## SECTION 07900

## JOINT SEALING

**06/97**

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## SECTION 07900

## JOINT SEALING

**06/97**

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 509	(1994) Elastomeric Cellular Preformed Gasket and Sealing Material
ASTM C 734	(1993) Low-Temperature Flexibility of Latex Sealants After Artificial Weathering
ASTM C 834	(1995) Latex Sealants
ASTM C 920	(1998) Elastomeric Joint Sealants
ASTM D 217	(1997) Cone Penetration of Lubricating Grease (IP50/88)
ASTM D 1056	(1998) Flexible Cellular Materials - Sponge or Expanded Rubber
ASTM E 84	(1999) Surface Burning Characteristics of Building Materials

## 1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

## SD-03 Product Data

Backing; G, AE.

Bond-Breaker; G, AE.

Sealant; G, AE.

Manufacturer's descriptive data including storage requirements, shelf life, curing time, instructions for mixing and application, and primer data (if required). A copy of the Material Safety Data Sheet shall be provided for each solvent, primer or sealant material. Include illustrations of range of available colors for

selection by Contracting Officer.

#### SD-07 Certificates

Sealant.

Certificates of compliance stating that the materials conform to the specified requirements.

### 1.3 ENVIRONMENTAL REQUIREMENTS

The ambient temperature shall be within the limits of 4 to 32 degrees C when the sealants are applied.

### 1.4 DELIVERY AND STORAGE

Materials shall be delivered to the job in the manufacturer's original unopened containers. The container label or accompanying data sheet shall include the following information as applicable: manufacturer, name of material, formula or specification number, lot number, color, date of manufacture, mixing instructions, shelf life, and curing time at the standard conditions for laboratory tests. Materials shall be handled and stored to prevent inclusion of foreign materials. Materials shall be stored at temperatures between 4 and 32 degrees C unless otherwise specified by the manufacturer.

## PART 2 PRODUCTS

### 2.1 BACKING

Backing shall be 25 to 33 percent oversize for closed cell and 40 to 50 percent oversize for open cell material, unless otherwise indicated.

#### 2.1.1 Rubber

Cellular rubber sponge backing shall be ASTM D 1056, Type 2, closed cell, Class A, round cross section.

#### 2.1.2 Synthetic Rubber

Synthetic rubber backing shall be ASTM C 509, Option I, Type I preformed rods or tubes.

#### 2.1.3 Neoprene

Neoprene backing shall be ASTM D 1056, closed cell expanded neoprene cord Type 2, Class C.

### 2.2 BOND-BREAKER

Bond-breaker shall be as recommended by the sealant manufacturer to prevent adhesion of the sealant to backing or to bottom of the joint.

### 2.3 PRIMER

Primer shall be non-staining type as recommended by sealant manufacturer for the application.

### 2.4 INTERIOR USE SEALANT

#### 2.4.1 Interior Areas Except in Restrooms and Shower Areas

Latex Sealant shall be ASTM C 834, color to match adjacent surfaces.

#### 2.4.2 Interior Areas in Restrooms and Shower Areas

Silicone Sealant: ASTM C 920, Type S, Grade NS, Class 25, use O; anti-microbial. Color to match adjacent surface.

#### 2.4.3 Accoustical

Rubber or polymer-based acoustical sealant shall have a flame spread of 25 or less and a smoke developed rating of 50 or less when tested in accordance with ASTM E 84. Acoustical sealant shall have a consistency of 250 to 310 when tested in accordance with ASTM D 217, and shall remain flexible and adhesive after 500 hours of accelerated weathering as specified in ASTM C 734, and shall be non-staining.

### 2.5 EXTERIOR USE SEALANT

Elastomeric sealants for exterior use shall conform to ASTM C 920 and the following:

- a. For use with concrete or masonry, Polyurethane sealant: Grade NS, Class 25, Use T for horizontal surfaces, Use NT for vertical surfaces, Use M and O; color to match adjacent surfaces.
- c. For use with metal or glass, Silicone sealant: Type S, Grade NS, Class 25, Use NT, G, A. Color to match adjacent surfaces.

### 2.6 SOLVENTS AND CLEANING AGENTS

Solvents, cleaning agents, and accessory materials shall be provided as recommended by the manufacturer.

## PART 3 EXECUTION

### 3.1 GENERAL

#### 3.1.1 Surface Preparation

The surfaces of joints to receive sealant or caulk shall be free of all frost, condensation and moisture. Oil, grease, dirt, chalk, particles of mortar, dust, loose rust, loose mill scale, and other foreign substances shall be removed from surfaces of joints to be in contact with the sealant.

Oil and grease shall be removed with solvent and surfaces shall be wiped dry with clean cloths. For surface types not listed below, the sealant manufacturer shall be contacted for specific recommendations.

#### 3.1.2 Concrete and Masonry Surfaces

Where surfaces have been treated with curing compounds, oil, or other such materials, the materials shall be removed by sandblasting or wire brushing. Laitance, efflorescence and loose mortar shall be removed from the joint cavity.

#### 3.1.3 Steel Surfaces

Steel surfaces to be in contact with sealant shall be sandblasted or, if sandblasting would not be practical or would damage adjacent finish work, the metal shall be scraped and wire brushed to remove loose mill scale. Protective coatings on steel surfaces shall be removed by sandblasting or by a solvent that leaves no residue.

#### 3.1.4 Aluminum Surfaces

Aluminum surfaces to be in contact with sealants shall be cleaned of temporary protective coatings. When masking tape is used for a protective cover, the tape and any residual adhesive shall be removed just prior to applying the sealant. Solvents used to remove protective coating shall be as recommended by the manufacturer of the aluminum work and shall be non-staining.

#### 3.1.5 Wood Surfaces

Wood surfaces to be in contact with sealants shall be free of splinters and sawdust or other loose particles.

### 3.2 APPLICATION

#### 3.2.1 Masking Tape

Masking tape shall be placed on the finish surface on one or both sides of a joint cavity to protect adjacent finish surfaces from primer or sealant smears. Masking tape shall be removed within 10 minutes after joint has been filled and tooled.

#### 3.2.2 Backing

Backing shall be installed to provide the indicated sealant depth. The installation tool shall be shaped to avoid puncturing the backing.

#### 3.2.3 Bond-Breaker

Bond-breaker shall be applied to fully cover the bottom of the joint without contaminating the sides where sealant adhesion is required.

#### 3.2.4 Primer

Primer shall be used on concrete masonry units, wood, or other porous surfaces in accordance with instructions furnished with the sealant. Primer shall be applied to the joint surfaces to be sealed. Surfaces adjacent to joints shall not be primed.

#### 3.2.5 Sealant

Sealant shall be used before expiration of shelf life. Multi-component sealants shall be mixed according to manufacturer's printed instructions. Sealant in guns shall be applied with a nozzle of proper size to fit the width of joint. Joints shall be sealed as detailed in the drawings. Sealant shall be forced into joints with sufficient pressure to expel air and fill the groove solidly. Sealant shall be installed to the indicated depth without displacing the backing. Unless otherwise indicated, specified, or recommended by the manufacturer, the installed sealant shall be dry tooled to produce a uniformly smooth surface free of wrinkles and to ensure full adhesion to the sides of the joint; the use of solvents, soapy water, etc., will not be allowed. Sealants shall be installed free of air

pockets, foreign embedded matter, ridges and sags. Sealer shall be applied over the sealant when and as specified by the sealant manufacturer.

### 3.3 CLEANING

The surfaces adjoining the sealed joints shall be cleaned of smears and other soiling resulting from the sealant application as work progresses.

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## SECTION 08110

## STEEL DOORS AND FRAMES

05/01

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## SECTION 08110

## STEEL DOORS AND FRAMES

05/01

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

## AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

- |             |                                                                                  |
|-------------|----------------------------------------------------------------------------------|
| ANSI A250.6 | (1997) Hardware on Standard Steel Doors<br>(Reinforcement - Application)         |
| ANSI A250.8 | (1998) SDI-100 Recommended Specifications<br>for Standard Steel Doors and Frames |

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

- |                   |                                                                                                                    |
|-------------------|--------------------------------------------------------------------------------------------------------------------|
| ASTM A 653/A 653M | (2000) Steel Sheet, Zinc-Coated<br>(Galvanized) or Zinc-Iron Alloy-Coated<br>(Galvannealed) by the Hot-Dip Process |
| ASTM A 924/A 924M | (1999) General Requirements for Steel<br>Sheet, Metallic-Coated by the Hot-Dip<br>Process                          |
| ASTM C 578        | (1995) Rigid, Cellular Polystyrene Thermal<br>Insulation                                                           |
| ASTM C 591        | (1994) Unfaced Preformed Rigid Cellular<br>Polyisocyanurate Thermal Insulation                                     |
| ASTM C 612        | (1993) Mineral Fiber Block and Board<br>Thermal Insulation                                                         |

## DOOR AND HARDWARE INSTITUTE (DHI)

- |          |                                                                                                                 |
|----------|-----------------------------------------------------------------------------------------------------------------|
| DHI A115 | (1991) Steel Door Preparation Standards<br>(Consisting of A115.1 through A115.6 and<br>A115.12 through A115.18) |
|----------|-----------------------------------------------------------------------------------------------------------------|

## NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

- |          |                                                             |
|----------|-------------------------------------------------------------|
| NFPA 80  | (1999) Fire Doors and Fire Windows                          |
| NFPA 105 | (1999) The Installation of Smoke-Control<br>Door Assemblies |
| NFPA 252 | (1999) Standard Methods of Fire Tests of<br>Door Assemblies |

## STEEL DOOR INSTITUTE (SDOI)

SDI 105	(1998) Recommended Erection Instructions for Steel Frames
SDI 111-C	Recommended Louver Details for Standard Steel Doors
SDI 111-F	Recommended Existing Wall Anchors for Standard Steel Doors and Frames

## UNDERWRITERS LABORATORIES (UL)

UL 10B	(1997) Fire Tests of Door Assemblies
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## 1.2 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures."

## SD-02 Shop Drawings

Doors; G, AE.

Frames; G, AE.

## Accessories

Show elevations, construction details, metal gages, hardware provisions, method of glazing, and installation details.

Schedule of doors; G, AE.

Schedule of frames; G, AE.

Submit door and frame locations.

## SD-03 Product Data

Doors; G, AE.

Frames; G, AE.

## Accessories

Submit manufacturer's descriptive literature for doors, frames, and accessories. Include data and details on door construction, panel (internal) reinforcement, insulation, and door edge construction. When "custom hollow metal doors" are provided in lieu of "standard steel doors," provide additional details and data sufficient for comparison to ANSI A250.8 requirements.

## 1.3 DELIVERY, STORAGE, AND HANDLING

Deliver doors, frames, and accessories undamaged and with protective wrappings or packaging. Provide temporary steel spreaders securely fastened to the bottom of each welded frame. Store doors and frames on platforms under cover in clean, dry, ventilated, and accessible locations, with 6 mm

airspace between doors. Remove damp or wet packaging immediately and wipe affected surfaces dry. Replace damaged materials with new.

## PART 2 PRODUCTS

### 2.1 STANDARD STEEL DOORS

ANSI A250.8, except as specified otherwise. Prepare doors to receive hardware specified in Section 08710, "Door Hardware." Undercut where indicated. Exterior doors shall have top edge closed flush and sealed to prevent water intrusion. Doors shall be 44.5 mm thick, unless otherwise indicated.

#### 2.1.1 Classification - Level, Performance, Model

##### 2.1.1.1 Heavy Duty Doors

ANSI A250.8, Level 2, physical performance Level B, Model 2, with core construction as required by the manufacturer, of size(s) and design(s) indicated. Where vertical stiffener cores are required, the space between the stiffeners shall be filled with mineral board insulation.

##### 2.1.1.2 Extra Heavy Duty Doors

ANSI A250.8, Level 3, physical performance Level A, Model 2 with core construction as required by the manufacturer for indicated exterior doors, of size(s) and design(s) indicated. Where vertical stiffener cores are required, the space between the stiffeners shall be filled with mineral board insulation. Provide Level 3 for all exterior doors and for doors to mechanical equipment rooms.

### 2.2 SOUND RATED STEEL DOORS

Sound rated doors are specified in Section 08385 SOUND RETARDANT SWINGING DOORS.

### 2.3 ACCESSORIES

#### 2.3.1 Louvers

##### 2.3.1.1 Interior Louvers

SDI 111-C, Louvers shall be stationary sightproof type where scheduled. Detachable moldings on room or non security side of door; on security side of door, moldings to be integral part of louver. Form louver frames of 0.9 mm thick steel and louver blades of a minimum 0.6 mm. Sightproof louvers to be inverted "V" or "Y" blade design with minimum 40 percent net-free opening.

##### 2.3.1.2 Exterior Louvers

Louvers shall be inverted "Y" or "V" or "Z" type with minimum of 30 percent net-free opening. Weld or tenon louver blades to continuous channel frame and weld assembly to door to form watertight assembly. Form louvers of hot-dip galvanized steel of same gage as door facings. Louvers shall have steel-framed insect screens secured to room side and readily removable. Provide aluminum wire cloth, 7 by 7 per 10 mm or 7 by 6 per 10 mm mesh, for insect screens. Net-free louver area to be before screening.

### 2.3.2 Astragals

For pairs of exterior steel doors which will not have aluminum astragals or removable mullions, as specified in Section 08710, "Door Hardware," provide overlapping steel astragals with the doors. For interior pairs of fire rated and smoke control doors, provide stainless steel astragals complying with NFPA 80 for fire rated assemblies and NFPA 105 for smoke control assemblies.

### 2.3.3 Moldings

Provide moldings around glass of interior and exterior doors and louvers of interior doors. Provide nonremovable moldings on outside of exterior doors and on corridor side of interior doors. Other moldings may be stationary or removable. Secure inside moldings to stationary moldings, or provide snap-on moldings. Muntins shall interlock at intersections and shall be fitted and welded to stationary moldings.

## 2.4 INSULATION CORES

Insulated cores shall be of type specified, and provide an apparent U-factor of .48 in accordance with SDI 113 and shall conform to:

- a. Rigid Polyurethane Foam: ASTM C 591, Type 1 or 2, foamed-in-place or in board form, with oxygen index of not less than 22 percent when tested in accordance with ASTM D 2863; or
- b. Rigid Polystyrene Foam Board: ASTM C 578, Type I or II; or
- c. Mineral board: ASTM C 612, Type I.

## 2.5 STANDARD STEEL FRAMES

ANSI A250.8, except as otherwise specified. Form frames to sizes and shapes indicated, with welded corners. Provide steel frames for doors, unless otherwise indicated.

### 2.5.1 Welded Frames

Continuously weld frame faces at corner joints. Mechanically interlock or continuously weld stops and rabbets. Grind welds smooth.

### 2.5.2 Cased Openings

Fabricate frames for cased openings of same material, gage, and assembly as specified for metal door frames, except omit door stops and preparation for hardware.

### 2.5.3 Anchors

Provide anchors to secure the frame to adjoining construction. Provide steel anchors, zinc-coated or painted with rust-inhibitive paint, not lighter than 1.2 mm thick.

#### 2.5.3.1 Wall Anchors

Provide at least three anchors for each jamb. For frames which are more than 2285 mm in height, provide one additional anchor for each jamb for each additional 760 mm or fraction thereof.

- a. Masonry: Provide anchors of corrugated or perforated steel straps or 5 mm diameter steel wire, adjustable or T-shaped;
- b. Stud partitions: Weld or otherwise securely fasten anchors to backs of frames. Design anchors to be fastened to closed steel studs with sheet metal screws, and to open steel studs by wiring or welding;
- c. Completed openings: Secure frames to previously placed concrete or masonry with expansion bolts in accordance with SDI 111-F; and

#### 2.5.3.2 Floor Anchors

Provide floor anchors drilled for 10 mm anchor bolts at bottom of each jamb member.

### 2.6 FIRE AND SMOKE DOORS AND FRAMES

Conform to NFPA 80 and NFPA 105 and this specification. The requirements of NFPA 80 and NFPA 105 shall take precedence over details indicated or specified.

#### 2.6.1 Labels

Fire doors and frames shall bear the label of Underwriters Laboratories (UL), Factory Mutual Engineering and Research (FM), or Warnock Hersey International (WHI) attesting to the rating required. Testing shall be in accordance with NFPA 252 or UL 10B. Labels shall be metal with raised letters, and shall bear the name or file number of the door and frame manufacturer. Labels shall be permanently affixed at the factory to frames and to the hinge edge of the door. Door labels shall not be painted.

#### 2.6.2 Astragal on Fire and Smoke Doors

On pairs of labeled fire doors, conform to NFPA 80 and UL requirements. On smoke control doors, conform to NFPA 105.

### 2.7 WEATHERSTRIPPING

As specified in Section 08710, "Door Hardware."

### 2.8 HARDWARE PREPARATION

Provide minimum hardware reinforcing gages as specified in ANSI A250.6. Drill and tap doors and frames to receive finish hardware. Prepare doors and frames for hardware in accordance with the applicable requirements of ANSI A250.8 and ANSI A250.6. For additional requirements refer to DHI A115.

Drill and tap for surface-applied hardware at the project site. Build additional reinforcing for surface-applied hardware into the door at the factory. Locate hardware in accordance with the requirements of ANSI A250.8, as applicable. Punch door frames, with the exception of frames that will have weatherstripping to receive a minimum of two rubber or vinyl door silencers on lock side of single doors and one silencer for each leaf at heads of double doors. Set lock strikes out to provide clearance for silencers.

### 2.9 FINISHES

### 2.9.1 Factory-Primed Finish

All surfaces of doors and frames shall be thoroughly cleaned, chemically treated and factory primed with a rust inhibiting coating as specified in ANSI A250.8, or paintable A25 galvanized steel without primer. Where coating is removed by welding, apply touchup of factory primer.

### 2.9.2 Hot-Dip Zinc-Coated and Factory-Primed Finish

Fabricate exterior doors and frames from hot dipped zinc coated steel, alloyed type, that complies with ASTM A 924/A 924M and ASTM A 653/A 653M. The Coating weight shall meet or exceed the minimum requirements for coatings having 122 grams per square meter, total both sides, i.e., ZF120. Repair damaged zinc-coated surfaces by the application of zinc dust paint. Thoroughly clean and chemically treat to insure maximum paint adhesion. Factory prime as specified in ANSI A250.8.

### 2.9.3 Electrolytic Zinc-Coated Anchors and Accessories

Provide electrolytically deposited zinc-coated steel in accordance with ASTM A 591, Commercial Quality, Coating Class A. Phosphate treat and factory prime zinc-coated surfaces as specified in ANSI A250.8.

## 2.10 FABRICATION AND WORKMANSHIP

Finished doors and frames shall be strong and rigid, neat in appearance, and free from defects, waves, scratches, cuts, dents, ridges, holes, warp, and buckle. Molded members shall be clean cut, straight, and true, with joints coped or mitered, well formed, and in true alignment. Dress exposed welded and soldered joints smooth. Design door frame sections for use with the wall construction indicated. Corner joints shall be well formed and in true alignment. Conceal fastenings where practicable. Design frames in exposed masonry walls or partitions to allow sufficient space between the inside back of trim and masonry to receive sealant.

### 2.10.1 Grouted Frames

For frames to be installed in exterior walls and to be filled with mortar or grout, fill the stops with strips of rigid insulation to keep the grout out of the stops and to facilitate installation of stop-applied head and jamb seals.

## PART 3 EXECUTION

### 3.1 INSTALLATION

#### 3.1.1 Frames

Set frames in accordance with SDI 105. Plumb, align, and brace securely until permanent anchors are set. Anchor bottoms of frames with expansion bolts or powder-actuated fasteners. Build in or secure wall anchors to adjoining construction.

#### 3.1.2 Doors

Hang doors in accordance with clearances specified in ANSI A250.8. After erection and glazing, clean and adjust hardware.

#### 3.1.3 Fire and Smoke Doors and Frames



Install fire doors and frames, including hardware, in accordance with NFPA 80. Install fire rated and smoke doors and frames in accordance with NFPA 80 and NFPA 105.

### 3.2 PROTECTION

Protect doors and frames from damage. Repair damaged doors and frames prior to completion and acceptance of the project or replace with new, as directed. Wire brush rusted frames until rust is removed. Clean thoroughly. Apply an all-over coat of rust-inhibitive paint of the same type used for shop coat.

### 3.3 CLEANING

Upon completion, clean exposed surfaces of doors and frames thoroughly. Remove mastic smears and other unsightly marks.

### 3.4 SCHEDULE

Some metric measurements in this section are based on mathematical conversion of inch-pound measurements, and not on metric measurement commonly agreed to by the manufacturers or other parties. The inch-pound and metric measurements are as follows:

<u>PRODUCTS</u>	<u>INCH-POUND</u>	<u>METRIC</u>
Door thickness	1 3/4 inches	44.5 mm
Steel channels	16 gage	1.5 mm
Steel Sheet	23 gage	0.7 mm
	16 gage	1.5 mm
	20 gage	0.9 mm
	18 gage	1.2 mm
Anchor bolts	3/8 inches	10 mm

-- End of Section --

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## DIVISION 08 - DOORS &amp; WINDOWS

## SECTION 08120

## ALUMINUM DOORS AND FRAMES

**09/99**

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## SECTION 08120

ALUMINUM DOORS AND FRAMES  
09/99

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

## ALUMINUM ASSOCIATION (AA)

AA DAF-45 (1980) Aluminum Finishes

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 36/A 36M (1997; Rev. A) Carbon Structural Steel

ASTM B 209M (1995) Aluminum and Aluminum-Alloy Sheet and Plate (Metric)

ASTM B 221M (1996) Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric)

ASTM E 331 (1996) Water Penetration of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference

## 1.2 SYSTEM DESCRIPTION

Frames and swing-type heavy duty aluminum doors, shall be provided at the locations indicated. Frames shall be furnished complete with doors, subframes, transoms, adjoining sidelights, adjoining window wall system, trim, and other accessories indicated and specified. Drawings are based on one manufacturer's standard. Another standard system of a similar and equivalent nature will be acceptable when differences do not detract from design concept or specified performances. Dimensional changes necessitated by the use of an alternate system shall be coordinated by the Contractor and shall be shown on shop drawings.

## 1.3 PERFORMANCE REQUIREMENTS

## 1.3.1 Structural

Shapes and thicknesses of framing members shall be sufficient to withstand the design wind load indicated with a deflection of not more than 1/175 times the length of the member and a safety factor of not less than 1.65. Provide glazing beads, moldings, and trim of not less than 1.25 mm nominal thickness.

## 1.3.2 Water Penetration

When tested in accordance with ASTM E 331, there shall be no water

penetration at a pressure of 0.576 kPa of fixed area.

#### 1.4 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures."

##### SD-02 Shop Drawings

Doors and frames; G, AE.

Show elevations of each door type, size of doors and frames, metal gages, details of door and frame construction, methods of anchorage, glazing details, weatherstripping, provisions for and location of hardware, and details of installation.

##### SD-08 Manufacturer's Instructions

Doors and frames

Submit detail specifications and instructions for installation, adjustments, cleaning, and maintenance.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

Inspect materials delivered to the site for damage. Unload and store with minimum handling. Provide storage space in dry location with adequate ventilation, free from dust or water, and easily accessible for inspection and handling. Stack materials on nonabsorptive strips or wood platforms. Do not cover doors and frames with tarps, polyethylene film, or similar coverings. Protect finished surfaces during shipping and handling using manufacturer's standard method, except that no coatings or lacquers shall be applied to surfaces to which calking and glazing compounds must adhere.

### PART 2 PRODUCTS

#### 2.1 DOORS AND FRAMES

Swing-type aluminum doors and frames of size, design, and location indicated. Provide doors complete with frames, removable mullions, and adjoining window wall and accessories, as specified in Section 08420 ALUMINUM VERTICAL WALL AND WINDOW SYSTEMS.

#### 2.2 MATERIALS

##### 2.2.1 Anchors

Stainless steel or steel with hot-dipped galvanized finish.

##### 2.2.2 Weatherstripping

Continuous wool pile, silicone treated, or type recommended by door manufacturer.

##### 2.2.3 Aluminum Alloy for Doors and Frames

ASTM B 221M, Alloy 6063-T5 or -T6 for extrusions. ASTM B 209M, alloy and temper best suited for aluminum sheets and strips.

#### 2.2.4 Fasteners

Hard aluminum or stainless steel.

#### 2.2.5 Structural Steel

ASTM A 36/A 36M.

#### 2.2.6 Aluminum Paint

Type as recommended by aluminum door manufacturer.

### 2.3 FABRICATION

#### 2.3.1 Aluminum Frames

Extruded aluminum shapes with contours approximately as indicated with 3 mm minimum thickness sidewalls where hardware is attached. Provide removable glass stops and glazing beads for frames accommodating fixed glass. Use countersunk stainless steel Phillips screws for exposed fastenings, and space not more than 300 mm o.c. Mill joints in frame members to a hairline fit, reinforce, and secure mechanically.

#### 2.3.2 Aluminum Doors

Of type, size, and design indicated and not less than 45 mm thick. Minimum wall thickness, 3 mm, except beads and trim, 1.25 mm. Door sizes shown are nominal and shall include standard clearances as follows: 2.5 mm at hinge and lock stiles, 3 mm between meeting stiles, 3 mm at top rails, 5 mm between bottom and threshold, and 17 mm between bottom and floor. Bevel single-acting doors 2 or 3 mm at lock, hinge, and meeting stile edges.

##### 2.3.2.1 Full Glazed Stile and Rail Doors

Doors shall have medium stiles and rails as indicated. Fabricate from extruded aluminum hollow seamless tubes or from a combination of open-shaped members interlocked or welded together. Fasten top and bottom rail together by means of welding or by 10 or 13 mm diameter cadmium-plated tensioned steel tie rods. Provide an adjustable mechanism of jack screws or other methods in the top rail to allow for minor clearance adjustments after installation.

#### 2.3.3 Welding and Fastening

Where possible, locate welds on unexposed surfaces. Dress welds on exposed surfaces smoothly. Select welding rods, filler wire, and flux to produce a uniform texture and color in finished work. Remove flux and spatter from surfaces immediately after welding. Exposed screws or bolts will be permitted only in inconspicuous locations, and shall have countersunk heads. Weld concealed reinforcements for hardware in place.

#### 2.3.4 Weatherstripping

Provide on stiles and rails of exterior doors. Fit into slots which are integral with doors or frames. Weatherstripping shall be replaceable without special tools, and adjustable at meeting rails of pairs of doors. Installation shall allow doors to swing freely and close positively. Air leakage of a single leaf weatherstripped door shall not exceed 0.775 L/S per lineal meter (0.5 CFM per lineal foot) of crack when tested in

accordance with ASTM E 283 at standard test conditions.

#### 2.3.5 Anchors

On the backs of subframes, provide anchors of the sizes and shapes indicated for securing subframes to adjacent construction. Anchor transom bars at ends and mullions at head and sill. Reinforce vertical mullions with structural steel members of sufficient length to extend up to the overhead structural framing and secure thereto as indicated on approved shop drawings and in accordance with manufacturer's recommendation. Place anchors near top and bottom of each jamb and at intermediate points not more than 300 mm apart.

#### 2.3.6 Provisions for Hardware

Hardware is specified in Section 08710, "Door Hardware." Deliver hardware templates and hardware (except field-applied hardware) to the door manufacturer for use in fabrication of aluminum doors and frames. Cut, reinforce, drill, and tap doors and frames at the factory to receive template hardware. Provide doors to receive surface-applied hardware, except push plates, kick plates, and mop plates, with reinforcing only; drill and tap in the field. Provide hardware reinforcements of stainless steel or steel with hot-dipped galvanized finish, and secure with stainless steel screws.

#### 2.3.7 Provisions for Glazing

Provide extruded aluminum snap-in glazing beads on interior side of doors. Provide extruded aluminum, theft-proof, snap-in glazing beads or fixed glazing beads on exterior or security side of doors. Glazing beads shall have vinyl insert glazing gaskets. Design glazing beads to receive glass of thickness indicated or specified. Glazing is specified in Section 08810, "Glass and Glazing."

#### 2.3.8 Finishes

Provide exposed aluminum surfaces with factory finish of anodic coating.

##### 2.3.8.1 Anodic Coating

Clean exposed aluminum surfaces and provide an anodized finish conforming to AA DAF-45. Finish shall be clear (natural), designation AA-M10-C22-A41, Architectural Class I 0.0175 mm or thicker).

### PART 3 EXECUTION

#### 3.1 INSTALLATION

Plumb, square, level, and align frames and framing members to receive doors, and, adjoining window walls. Anchor frames to adjacent construction as indicated and in accordance with manufacturer's printed instructions. Anchor bottom of each frame to rough floor construction with 2.4 mm thick stainless steel angle clips secured to back of each jamb and to floor construction; use stainless steel bolts and expansion rivets for fastening clip anchors. Seal metal-to-metal joints between framing members as specified in Section 07900, "Joint Sealing." Hang doors to produce clearances specified in paragraph entitled "Aluminum Doors," of this section. After erection and glazing, adjust doors and hardware to operate properly.

### 3.2 PROTECTION FROM DISSIMILAR MATERIALS

#### 3.2.1 Dissimilar Metals

Where aluminum surfaces come in contact with metals other than stainless steel, zinc, or small areas of white bronze, protect from direct contact by one or a combination of the following methods:

- a. Paint the dissimilar metal with one coat of heavy-bodied bituminous paint.
- b. Apply a good quality elastomeric sealant between the aluminum and the dissimilar metal.
- c. Paint the dissimilar metal with one coat of primer and one coat of aluminum paint.
- d. Use a nonabsorptive tape or gasket in permanently dry locations.

#### 3.2.2 Drainage from Dissimilar Metals

In locations where drainage from dissimilar metals has direct contact with aluminum, provide protective paint, to prevent aluminum discoloration.

#### 3.2.3 Masonry and Concrete

Provide aluminum surfaces in contact with mortar, concrete, or other masonry materials with one coat of heavy-bodied bituminous paint.

### 3.3 CLEANING

Upon completion of installation, clean door and frame surfaces in accordance with door manufacturer's recommended procedure.

### 3.4 PROTECTION

Protect doors and frames from damage and from contamination by other materials such as cement mortar. Prior to completion and acceptance of the work, restore damaged doors and frames to original condition, or replace with new ones.

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SECTION 08210

WOOD DOORS

**09/99**

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## SECTION 08210

WOOD DOORS  
09/99

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

## ARCHITECTURAL WOODWORK INSTITUTE (AWI)

AWI Qual Stds	(1997) Architectural Woodwork Quality Standards and Quality Certification Program
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## WINDOW AND DOOR MANUFACTURERS ASSOCIATION (WDMA)

WDMA I.S. 1-A	(1993) Architectural Wood Flush Doors
WDMA TM-5	(1990) Split Resistance Test
WDMA TM-7	(1990) Cycle - Slam Test
WDMA TM-8	(1990) Hinge Loading Resistance Test

## 1.2 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures."

## SD-02 Shop Drawings

Doors; G, AE.

Submit drawings or catalog data showing each type of door unit. Drawings and data shall indicate door type and construction, sizes, thickness, and glazing.

## SD-03 Product Data

Doors; G, AE.

Accessories

Water-resistant sealer

Sample warranty

## SD-04 Samples

Doors

Prior to the delivery of wood doors, submit a sample section of

each type of door which shows the stile, rail, veneer, finish, and core construction.

Door finish colors; G-AO

Submit a minimum of three color selection samples.

#### SD-06 Test Reports

Split resistance

Cycle-slam

Hinge loading resistance

Submit split resistance test report for doors tested in accordance with WDMA TM-5, cycle-slam test report for doors tested in accordance with WDMA TM-7, and hinge loading resistance test report for doors tested in accordance with WDMA TM-8.

### 1.3 DELIVERY, STORAGE, AND HANDLING

Deliver doors to the site in an undamaged condition and protect against damage and dampness. Stack doors flat under cover. Support on blocking, a minimum of 100 mm thick, located at each end and at the midpoint of the door. Store doors in a well-ventilated building so that they will not be exposed to excessive moisture, heat, dryness, direct sunlight, or extreme changes of temperature and humidity. Do not store in a building under construction until concrete, masonry work, and plaster are dry. Replace defective or damaged doors with new ones.

### 1.4 WARRANTY

Warranty shall warrant doors free of defects as set forth in the door manufacturer's standard door warranty.

## PART 2 PRODUCTS

### 2.1 DOORS

Provide doors of the types, sizes, and designs indicated.

#### 2.1.1 Flush Doors

Flush doors shall conform to WDMA I.S. 1-A. Stile edge bands of doors to receive natural finish shall be hardwood, compatible with face veneer. No visible finger joints will be accepted in stile edge bands. When used, locate finger-joints under hardware.

##### 2.1.1.1 Interior Flush Doors

Provide particleboard core, Type II flush doors conforming to WDMA I.S. 1-A with faces of custom grade redoak. Hardwood veneers shall be plain sliced book matched.

### 2.2 ACCESSORIES

#### 2.2.1 Door Light Openings

Provide glazed openings with same specie and color as the face veneers. Moldings for flush doors shall be lip type. Glazing is specified in Section 08810, "Glass and Glazing."

#### 2.2.2 Additional Hardware Reinforcement

Provide fire rated doors with hardware reinforcement blocking. Size of lock blocks shall be as required to secure the hardware specified. Reinforcement blocking shall be in compliance with the manufacturer's labeling requirements and shall not be mineral material similar to the core.

### 2.3 FABRICATION

#### 2.3.1 Marking

Each door shall bear a stamp, brand, or other identifying mark indicating quality and construction of the door.

#### 2.3.2 Quality and Construction

Identify the standard on which the construction of the door was based.

#### 2.3.3 Adhesives and Bonds

WDMA I.S. 1-A. Use Type II bond for interior doors. Adhesive for doors to receive a natural finish shall be nonstaining.

#### 2.3.4 Finishes

##### 2.3.4.1 General

Provide factory finish to match color and sheen of existing doors.  
(Similar to Mahogany Color)

##### 2.3.4.2 Factory Finish

Provide doors finished at the factory by the door manufacturer as follows: AWI Qual Stds Section 1500, specification for System No. TR-3 or TR-4. The coating shall be AWI Qual Stds premium, medium rubbed sheen, closed grain effect. Use stain when required to produce the finish specified for color.

Seal edges, cutouts, trim, and wood accessories, and apply two coats of finish compatible with the door face finish. Touch-up finishes that are scratched or marred, or where exposed fastener holes are filled, in accordance with the door manufacturer's instructions. Match color and sheen of factory finish using materials compatible for field application.

##### 2.3.4.3 Color

Provide door finish colors as selected by the Contracting Officer from the color selection samples.

### 2.4 SOURCE QUALITY CONTROL

Stiles of "B" and "C" label fire doors utilizing standard mortise leaf hinges shall meet the following performance criteria:

- a. Split resistance: Average of ten test samples shall be not less than 225 kilograms load when tested in accordance with WDMA TM-5.

- b. Cycle-slam: 200,000 cycles with no loose hinge screws or other visible signs of failure when tested in accordance with the requirements of WDMA TM-7.
- c. Hinge loading resistance: Average of ten test samples shall be not less than 315 kilograms load when tested for direct screw withdrawal in accordance with WDMA TM-8 using a No. 12, 30 mm long, steel, fully threaded wood screw. Drill 4 mm pilot hole, use 40 mm opening around screw for bearing surface, and engage screw full, except for last 3 mm. Do not use a steel plate to reinforce screw area.

### PART 3 EXECUTION

#### 3.1 INSTALLATION

Before installation, seal top and bottom edges of doors with the approved water-resistant sealer. Seal cuts made on the job immediately after cutting using approved water-resistant sealer. Fit, trim, and hang doors with a 2 mm minimum, 3 mm maximum clearance at sides and top, and a 5 mm minimum, 6 mm maximum clearance over thresholds. Provide 10 mm minimum, 11 mm maximum clearance at bottom where no threshold occurs. Bevel edges of doors at the rate of 3 mm in 50 mm. Door warp shall not exceed 6 mm when measured in accordance with WDMA I.S. 1-A.

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## SECTION 08330

## OVERHEAD ROLLING DOORS

**09/02**

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## SECTION 08330

## OVERHEAD ROLLING DOORS

09/02

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## ASTM INTERNATIONAL (ASTM)

ASTM A 653/A 653M	(2001a) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip process
ASTM E 330	(1997e1) Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference

## NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 2	(2002) Industrial Controls and Systems Controllers, Contactors, and Overload Relays Rated Not More Than 2,000 Volts AC or 750 Volts DC
NEMA ICS 6	(1993; R 2001) Industrial Control and Systems Enclosures
NEMA MG 1	(1998) Motors and Generators

## NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2002) National Electrical Code
NFPA 80	(1999) Fire Doors and Fire Windows

## 1.2 DESCRIPTION

Overhead rolling doors shall be motor operated, weight counterbalanced, rolling type, with interlocking slats, complete with guides, fastenings, hood, brackets, and operating mechanisms, and shall be designed for use on openings as indicated. Each door shall be provided with a permanent label showing the manufacturer's name and address and the model/serial number of the door. Doors in excess of the labelled size shall be deemed oversize and shall be provided with a listing agency oversize label, or a listing agency oversize certificate, or a certificate signed by an official of the manufacturing company certifying that the door and operator have been designed to meet the specified requirements.

## 1.2.1 Wind Load Requirements



Doors and components shall be designed to withstand the minimum design wind load of 960 Pa. Doors shall be constructed to sustain a superimposed load, both inward and outward, equal to 1-1/2 times the minimum design wind load.

Calculations or test data showing compliance with design windload requirements for the specific door design in accordance with the uniform static air pressure difference test procedures of ASTM E 330 shall be provided. Recovery shall be at least 3/4 of the maximum deflection within 24 hours after the test load is removed. Sound engineering principles may be used to interpolate or extrapolate test results to door sizes not specifically tested

#### 1.2.2 Operational Cycle Life

All portions of the door and door operating mechanism that are subject to movement, wear, or stress fatigue shall be designed to operate through a minimum number of 40 cycles per day. One complete cycle of door operation is defined as when the door is in the closed position, moves to the full open position, and returns to the closed position.

#### 1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

##### SD-02 Shop Drawings

Approved Detail Drawings; G, AE.  
Installation.

Drawings showing the location of each door including schedules. Drawings shall include elevations of each door type, details and method of anchorage, details of construction, location and installation of hardware, shape and thickness of materials, details of joints and connections, and details of guides, power operators, controls, and other fittings.

##### SD-03 Product Data

Overhead Rolling Doors; G, AE.

Manufacturer's catalog data, test data, and summary of forces and loads on the walls/jambs.

Manufacturer's preprinted installation instructions.

##### SD-04 Samples

Overhead Rolling Doors; G, AE.

Manufacturer's standard color samples of factory applied finishes.

##### SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals.

Six copies of the system operation manual and system maintenance and repair manual for each type of door and control system.

#### 1.4 DELIVERY AND STORAGE

Doors shall be delivered to the jobsite wrapped in a protective covering with the brands and names clearly marked thereon. Doors shall be stored in a dry location that is adequately ventilated and free from dirt and dust, water, and other contaminants, and in a manner that permits easy access for inspection and handling.

#### 1.5 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a 1-year period shall be provided.

#### 1.6 OPERATION AND MAINTENANCE MANUALS

Operating instructions outlining the step-by-step procedures required for motorized door and shutter operation for the overhead rolling door unit shall be provided. The instructions shall include the manufacturer's name, model number, service manual, parts list, and brief description of all equipment and their basic operating features. Maintenance instructions listing routine maintenance procedures, possible breakdowns and repairs, troubleshooting guides, and simplified diagrams for the equipment as installed shall be provided. A complete list of parts and supplies, source of supply, and a list of the high mortality maintenance parts shall be provided.

### PART 2 PRODUCTS

#### 2.1 OVERHEAD ROLLING DOORS

Doors shall be surface-mounted type with guides and counter weights at jambs set back a sufficient distance to clear the opening. Exterior doors shall be mounted on interior side of walls.

##### 2.1.1 Curtains

The curtains shall roll up on a barrel supported at the head of opening on brackets, and shall be balanced by weights. Steel slats for doors from 4.6 to 6.4 m wide shall be minimum bare metal thickness of 0.87 mm. Slats shall be of the minimum bare metal decimal thickness required for the width indicated and the wind pressure specified above.

##### 2.1.1.1 Non-Insulated Curtains

Curtains shall be formed of interlocking contour slats of shapes standard with the manufacturer.

##### 2.1.2 Endlocks and Windlocks

The ends of each alternate slat for interior doors shall have endlocks of manufacturer's stock design. In addition to endlocks, non-rated exterior doors shall have the manufacturer's standard windlocks as required to withstand the wind load. Windlocks shall prevent the curtain from leaving guides because of deflection from specified wind pressure.

##### 2.1.3 Bottom Bar

The curtain shall have a standard bottom bar consisting of two hot-dip galvanized steel angles for steel doors. A sensing edge shall be attached to the bottom bar of doors that are electric-power operated.

#### 2.1.1.4 Guides

Guides shall be steel structural shapes or formed steel shapes, of a size and depth to provide proper clearance for operation and resistance under the design windload. Guides shall be attached to adjoining construction with fasteners recommended by the manufacturer. Spacing of fasteners shall be as required to meet the minimum design windload. Doors and guides in hazardous areas shall have static grounding.

#### 2.1.1.5 Barrel

The barrel shall be steel pipe or commercial welded steel tubing of proper diameter for the size of curtain. Deflection shall not exceed 2.5 mm per meter of span. Ends of the barrel shall be closed with metal plugs, machined to fit the pipe. Aluminum plugs are acceptable on non-fire door barrels.

#### 2.1.1.6 Counterweights

Counterweights shall consist of steel weights suspended on 3 mm stainless steel cable, and protected by galvanized steel enclosures at each jamb of the door.

#### 2.1.1.7 Brackets

Brackets shall be of steel plates to close the ends of the roller-shaft housing, and to provide mounting surfaces for the hood. An operation bracket hub and shaft plugs shall have sealed prelubricated ball bearings.

#### 2.1.1.8 Hoods

Hoods shall be steel with minimum bare metal thickness of 0.56 mm formed to fit contour of the end brackets, and shall be reinforced with steel rods, rolled beads, or flanges at top and bottom edges. Multiple segment and single piece hoods shall be provided with support brackets of the manufacturer's standard design as required for adequate support.

#### 2.1.1.9 Weatherstripping

Exterior doors shall be fully weatherstripped. A compressible and replaceable weather seal shall be attached to the bottom bar. Weather seal at door guides shall be continuous vinyl or neoprene, bulb or leaf type, or shall be nylon-brush type. A weather baffle shall be provided at the lintel or inside the hood. Weatherstripping shall be easily replaced without special tools.

#### 2.1.1.10 Operation

Doors shall be operated by means of electric power with auxiliary chain hoist. Equipment shall be designed and manufactured for usage in non-hazardous areas.

##### 2.1.10.1 Electric Power Operator With Auxiliary Chain Hoist Operation

Electric power operators shall be heavy-duty industrial type. The unit shall operate the door through the operational cycle life specified. The electric power operator shall be complete with electric motor, auxiliary operation, self-locking worm gear in oil bath for heavy-duty doors, brake, mounting brackets, push button controls, limit switches, magnetic reversing starter, and all other accessories necessary to operate components specified in other paragraphs of this section. The operator shall be so designed that the motor may be removed without disturbing the limit-switches settings and without affecting the emergency chain operator.

Doors shall be provided with an auxiliary operator for immediate emergency manual operation of the door in case of electrical failure. Auxiliary operation shall be by means of galvanized endless chain extending to within 915 mm of the floor. The emergency manual operating mechanism shall be so arranged that it may be operated from the floor without affecting the settings of the limit switches. A mechanical device shall be included that will disconnect the motor from the drive operating mechanism when the auxiliary operator is used. Where control voltages differ from motor voltage, a control voltage transformer shall be provided in and as part of the electric power operator system. Control voltage shall not exceed 120 volts.

a. Motors: Drive motors shall conform to NEMA MG 1, shall be high-starting torque, reversible type, and shall be of sufficient wattage and torque output to move the door in either direction from any position at a speed range of 0.18 m per second (6 to 8 inches per second) without exceeding the rated capacity. Motors shall be suitable for operation on 120 volts, 60 hertz, single phase current and shall be suitable for across-the-line starting. Motors shall be designed to operate at full capacity over a supply voltage variation of plus or minus 10 percent of the motor voltage rating. Motors shall be provided with overload protection.

b. Controls: Control equipment shall conform to NEMA ICS 2. Enclosures shall conform to NEMA ICS 6, Type 12 (industrial use), Type 7 in accordance with NFPA 70. Exterior control stations shall be weatherproof card -operated type with weather-resistant enclosure mounted in pedestal,. Interior operation: Card operation, plus key-operated switch on door jamb with key positions "on" and "off". Card reader shall open door. Door shall close after a time delay. Readily adjustable limit switches shall be provided to automatically stop the doors at their fully open and closed positions.

c. Sensing Edge Device: The bottom edge of electric power operated doors shall have an electric sensing edge for non-hazardous areas that will reverse the door movement upon contact with an obstruction and cause the door to return to its full open position. The sensing edge shall not substitute for a limit switch. Exterior doors shall be provided with a combination compressible weather seal and sensing edge.

d. Electrical Work: Conduit and wiring necessary for proper operation shall be provided under Section 16415A ELECTRICAL WORK, INTERIOR. Flexible connections between doors and fixed supports shall be made with flexible type SJO cable, except in hazardous locations where wiring shall conform to NFPA 70, as appropriate. The cable shall have a spring-loaded automatic take up reel or a coil cord equivalent device.

#### 2.1.11 Inertia Brake

Overhead rolling door shall have a mechanical inertia brake device which will stop the door from free fall in any position, should there be a

failure in the motor operator brake or roller chain drive. The unit shall be capable of being reset with a back drive action.

#### 2.1.12 Locking

Locking for motor operated doors shall consist of self-locking gearing with chain lock for emergency hand chain.

#### 2.1.13 Finish

Steel slats and hoods shall be hot-dip galvanized G90 in accordance with ASTM A 653/A 653M, and shall be treated for paint adhesion and shall receive a factory baked-on finish powder coat. Surfaces other than slats, hood, and faying surfaces shall be cleaned and treated to assure maximum paint adherence and shall be given a factory dip or spray coat of rust inhibitive metallic oxide or synthetic resin primer. Color shall be as selected by the Contracting Officer.

### PART 3 EXECUTION

#### 3.1 INSTALLATION

Doors shall be installed in accordance with approved detail drawings and manufacturer's instructions. Anchors and inserts for guides, brackets, motors, switches, hardware, and other accessories shall be accurately located. Upon completion, doors shall be free from warp, twist, or distortion. Doors shall be lubricated, properly adjusted, and demonstrated to operate freely. Fire doors shall be installed in conformance with the requirements of NFPA 80 and the manufacturer's instructions.

-- End of Section --

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## SECTION 08385

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## SECTION 08385

## SOUND RETARDANT SWINGING DOORS

## PART 1 GENERAL

## 1.1 GENERAL

A. Provide acoustical and security swinging door and frame units as a complete tested assembly. Each door package shall include door, frame, anchors, sound seals, drop bottoms, threshold and all other hardware specified under Section 08710 DOOR HARDWARE.

B. Each door unit and frame shall provide a minimum tested rating as indicated in this Specification and Door Schedule.

C. There are security hardware items listed in Section 08710, DOOR HARDWARE, that are to be installed in conjunction with the sound retardant doors. Preparation of the doors and door frames and the installation of the security hardware shall be provided by the manufacturer of the sound retardant doors so that the STC rating of the assembly is not compromised.

## 1.2 QUALITY ASSURANCE

A. Sound seals shall be adjustable so that they may be adjusted to maintain the performance requirements during the life of the project.

## 1.3 REFERENCES

The publications listed below from a part of this specification. The publications are referred to in the text by basic designation.

## AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A 115.1 (1994) Installation Guide for Doors and Hardware

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM E 336 (1997) Test Method for Measurement of Airborne Sound Insulation in Buildings

ASTM E 90 (1997) Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions

ASTM E 413 (1987, R 1994) Classification for Rating Sound Insulation

## DIRECTOR OF CENTRAL INTELLIGENCE DOCUMENTS

DCID (2002) Physical Security Standards for Sensitive Compartmented Facilities (SCIFs)



#### 1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

##### SD-02 Shop Drawings

Doors and Frames; G, AE.

Drawings shall indicate the location of each door and frame, elevation of each model of door and frame, details of construction, method of assembling section location and extent of hardware reinforcement, hardware locations, type and location of struts and anchors for frames, and thickness of metal.

Drawing shall include catalog cuts or descriptive data for the cam lift hinges, thresholds, and sill seals.

##### SD-07 Certificates

Sound Rated Doors; G, AE.

Certification that the door construction utilized has been tested at independent laboratory in accordance with ASTM E 90 and that the STC determined in accordance with ASTM E 413 is not less than that specified in Part 2 of this Section. The laboratory referenced in the certification must be qualified under the National Voluntary Laboratory Accreditation Program (NAVLAP) of the National Institute of Standards and Technology (NIST). The certification shall include the laboratory name, test report number(s), and date(s) of test. Certifications of acoustical tests older than 5 years are not acceptable and are considered invalid.

#### 1.5 DELIVERY AND STORAGE

Ship door leaves and frames to site, factory assembled as complete units. Doors shall have the wrappings or coverings removed upon delivery at the building site and shall be stored in a vertical position, in a dry location, spaced blocking to permit air circulation between them.

### PART 2 PRODUCTS

#### 2.1 GENERAL REQUIREMENTS

Provide sound retardant doors and frames, including gaskets, hinges, and hardware as an assembly by a single firm specializing in producing this type of product with minimum of ten years experience.

Design is based on using acoustical door systems manufactured by Industrial Acoustics Company, Inc. and proprietary products and methods of the company. It is not the intent of this specification to restrict competitive bidding. Provide the products upon which the design is based, or products which are approved equal.

#### 2.2 DOORS

Provide acoustical swinging doors to meet STC 51/NIC 45, Sound Group 3 rating in accordance with ASTM E 90 and as determined according to ASTM E 413. Meet physical security standards to comply with DCID 1/21 and 6/9,

latest edition.

## 2.2.1 Description of Sound Retardant Door System

### 2.2.1.1 Door Leaf

63 mm (2 1/2 inch) thickness fabricated from 2 mm (16 gage) steel, filled with 6 lb. density acoustical material. Provide galvanealed finish.

### 2.2.1.2 Frame

2-Piece, 1.5 mm (16 gage) steel, mitered and welded. One piece exposed to interior; one piece exposed to exterior of room. Provide galvanealed A-60 finish.

### 2.2.1.3 Head and Jamb Seals

2-sets of self-aligning, magnetic, compressive seals providing acoustical labyrinth in closed portion, at top and jambs.

### 2.2.1.4 Sill Seal

Continuous, adjustable, resilient compressive seal gravity activated only when door is closed.

### 2.2.1.5 Hardware

Include installation of hardware as required by ANSI A 115.1, as specified in Section 08710 DOOR HARDWARE, without reduction in STC value.

### 2.2.1.6 Hardware Reinforcement

Provide 6 x 51 x 191 mm (1/4 x 2 x 7-1/2 inch) hinge reinforcement. Provide 5 mm (3/16 inch) strike reinforcement for lock boxes and closers in doors.

## 2.3 FABRICATION

Finished work shall be strong and rigid, neat in appearance, square, trim and free of defects, warp or buckle. Molded members shall be clean cut, straight and of uniform profile throughout their lengths. Corner joints shall have all contact edges closed tight, with trim faces mitered and continuously welded.

### 2.3.1 Floor Anchors

Floor anchors shall be securely welded inside each jamb, with two holes provided at each jamb for floor anchorage. Adjustable floor anchors, providing not less than 2 inch height adjustment, shall be provided.

### 2.3.2 Jamb Anchors

Frames for installation in stud partitions shall be provided with steel anchors of suitable design, not less than 14 gauge thickness, securely welded inside each jamb at 305 mm (12 inch) spacings.

### 2.3.3 Painting and Cleaning of Door and Frames

After fabrication, tool marks and surface imperfections shall be removed

and exposed faces of welded joints dressed smooth. Frames shall be chemically treated to insure maximum paint adhesion and coated on accessible surfaces with a rust-inhibit primer which is fully cured before shipment. For finish painting refer to Section 09900, PAINTING, GENERAL.

### PART 3 EXECUTION

#### 3.1 INSTALLATION

Install the sound retardant doors and frames in strict accordance with the manufacturer's recommendations positioning all components plumb, level, square, firmly anchored into position, and operating in accordance with the design criteria. Check all frames prior to installation for size, swing, square, alignment, twist and plumb. Permissible installation tolerances shall not exceed the manufacturer's guidelines.

##### 3.1.1 Hardware

Install finish hardware items in strict accordance with the recommendations of the door manufacturer.

##### 3.1.2 Gaskets

Gasket retainers, retainer covers and gaskets shall be installed and adjusted in accordance with manufacturer's instructions.

#### 3.2 INSPECTION

The door manufacturer's technical representative, who currently has at least five years of installation experience, shall provide technical assistance during door and frame installation. The representative shall verify that each component is properly installed; and, the technical representative shall make all necessary adjustments to achieve optimum operation.

#### 3.3 TESTING

The contractor shall perform post installation tests of all installed door units in accordance with ASTM E 336. Door assemblies shall provide NIC values within 5 dB of specified STC rating. The tests shall be witnessed by the Contracting Officer and User Technical Representatives. Findings contained in the test report(s) shall be provided to the Contracting Officer as evidence of compliance and for warranty considerations. Coordinate sound testing with testing required under section 09250 GYPSUM BOARD.

##### 3.3.1 Test Procedure

Place a calibrated noise source that generates sound at accurate frequency and noise levels inside secure room. Produce sound at one-third octave band center frequencies and measure sound level outside of room in front of door.

##### 3.3.2 Test Reporting

Determine sound loss for each frequency and report noise isolation class (NIC) calculated in accordance with ASTM E 413.

##### 3.3.3 Corrections

At any doors that test deficiently isolate and correct all observed noise leakages. If necessary, remove and replace doors and frames to correct deficient noise isolation performance. Retest and report findings.

#### 3.4 INSTRUCTION

Instruct the Government's Maintenance Personnel regarding the operation and maintenance of these doors. Provide one hour of instruction to maintenance personnel. Notify Contracting Officer 14 days in advance of the time during which instruction is to occur.

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## DIVISION 08 - DOORS &amp; WINDOWS

## SECTION 08420

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## SECTION 08420

## ALUMINUM VERTICAL WALL AND WINDOW SYSTEMS

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## ALUMINUM ASSOCIATION (AA)

AA DAF-45 (1980) Aluminum Finishes

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 123 (1989a) Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

ASTM B 209 (1996) Aluminum and Aluminum-Alloy Sheet and Plate

ASTM B 221 (1996) Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wires, Shapes, and Tubes

ASTM C 1184 (2000) Specification for Structural Silicone Sealants

ASTM C 1401 (2002) Guide for Structural Sealant Glazing

ASTM E 283 (1991) Test Method for Rate of Air Leakage Through Exterior Windows, Curtain Walls and Doors

ASTM E 330 (1996) Test Method for Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Differences

ASTM E 331 (1996) Test method for Water Penetration of Exterior Windows, Curtain Walls and Doors by Uniform Static Air Pressure Differences

## AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)

AAMA 101 (1997) Voluntary Specifications for Aluminum, Vinyl (PVC) and Wood Windows and Glass Doors

## 1.2 GENERAL REQUIREMENTS

Provide heavy duty vertical wall systems manufactured by a single firm specializing in the production of this type of work. The vertical wall system and the aluminum entrances and storefront and windows shall be products of the same manufacturer.

Drawings are based on one manufacturer's systems. Another standard system of a similar and equivalent nature will be acceptable when differences do not detract from design concept or specified performances. Dimensional changes necessitated by the use of an alternative system shall be coordinated by the Contractor and shall be on shop drawings.

## 1.3 SYSTEM DESCRIPTION

Provide heavy duty aluminum glazing assemblies, with thermal break framing, that comply with specified performance characteristics. Each system shall be tested by a recognized testing laboratory or agency in accordance with specified test methods. Provide certified test results.

### 1.3.1 Thermal Movement

Provide systems capable of withstanding thermal movements resulting from an ambient temperature range of 49 degrees C that could cause a metal surface temperature range of 82 degrees C within the framing system.

### 1.3.2 Wind Loading

Provide exterior components which have been tested in accordance with ASTM E 330 to withstand wind loads indicated with a maximum deflection of L/190.

### 1.3.3 Blast Loading

Design frames, mullions, and window hardware to resist a static load of 7 kPa (1 psi) applied to the surface of glazing. Design frame connections to surrounding walls to resist a combined ultimate load consisting of tension forces of 35 kn/m (200 lb/in) and a shear force of 13-kn/m (75 lb/in).

### 1.3.4 Air Infiltration

Provide framing systems with an air infiltration rate of not more than 0.06 CFM/sq. ft. of fixed area when tested in accordance with ASTM E 283 at an inward test pressure differential of 0.29 KPa.

### 1.3.5 Water Penetration

There shall be no uncontrolled water entry when tested in accordance with ASTM E 331 at a static pressure of .574 KPa.

### 1.3.6 Framing System

Framing systems for all glazing and entrances shall be specifically designed to provide the equivalent minimum bite of 25 mm (1 inch) for Glass Edge. This equivalent may be composed of a combination of bite and structural sealant.

## 1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation;

submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

#### SD-02 Shop Drawings

Aluminum Framing Systems; G, AE.

Drawings shall include manufacturer's descriptive data, catalog cuts and installation instructions. Include tolerance requirements for installation dimensions.

A schedule showing the location of each system shall be included with the drawings. Drawings shall indicate elevations and frame type, details and method of anchorage, depth of glass bite, details of construction, shape and thickness of materials, and details of joints and connections. Drawing shall include catalog cuts or descriptive data for the air infiltration data.

#### SD-04 Samples

Finishes; G, AO.

Samples of finish illustrating expected range of color and texture.

#### SD-06 Test Reports

Aluminum Framing Systems; .

Certified test reports shall state that systems meet the specified test and performance requirements.

### 1.5 PROJECT CONDITIONS

Check openings by field measurements before fabrication to ensure proper fitting of work; show measurements on final shop drawings. Coordinate fabrication schedule with construction progress to avoid delay in the work.

Where necessary, proceed with fabrication without field measurements, and coordinate fabrication tolerances to ensure proper fit.

### 1.6 COORDINATION

Coordinate installation with Section 05811 ARCHITECTURAL JOINT SYSTEMS, Section 07413 COMPOSITE METAL SIDING, Section 08210 ALUMINUM DOORS AND FRAMES, and Section 07600 SHEET METAL WORK pick provide a weathertight installation with a consistent, unified appearance.

## PART 2 PRODUCTS

### 2.1 ALUMINUM MEMBERS

Provide alloy and temper recommended by the manufacturer for strength, corrosion resistance, and application of required finish; comply with ASTM B 221 for extrusions and ASTM B 209 for sheet or plate. Provide main extrusions of not less than 2.0 mm wall thickness. Provide extruded glazing stops and other applied trim extrusion with minimum wall thickness of 1.5 mm.



## 2.2 FASTENERS

Provide fasteners of aluminum, nonmagnetic stainless steel, or other materials warranted by the manufacturer to be noncorrosive and compatible with aluminum components, hardware, anchors and other components. Where fasteners screw anchor into aluminum less than 2.0 mm thick, reinforce the interior with aluminum or nonmagnetic stainless steel to receive screw threads, or provide standard noncorrosive pressed-in splined grommet nuts. Except where unavoidable for application of hardware, to not use exposed fasteners. For the application of hardware, use fasteners that match the finish of member of hardware being fastened. Provide Phillips flat-head machine screws for exposed fasteners.

## 2.3 CONCEALED FLASHING

Provide 26 gauge minimum dead-soft stainless steel, or 1 mm minimum extruded aluminum of alloy and type selected by manufacturer for compatibility with other components.

## 2.4 BRACKETS AND REINFORCEMENTS

Provide high-strength aluminum brackets and reinforcements or provide nonmagnetic stainless steel or hot-dip galvanized steel. Minimum bolt size shall be 9 mm.

## 2.5 CONCRETE/MASONRY INSERTS

Provide concrete and masonry inserts fabricated from cast-iron, malleable iron, or hot-dip galvanized steel complying with ASTM A 123.

## 2.6 GLASS AND GLAZING MATERIALS

Refer Section 08810, GLASS AND GLAZING.

## 2.7 SEALANTS AND GASKETS

Provide sealants and gaskets in the fabrication, assembly and installation of the work, which are recommended and guaranteed by the manufacturer to remain permanently elastic, non-shrinking, non migrating and weatherproof.

### 2.7.1 Structural Sealant Glazing

Comply with recommendations in ASTM C 1401. Provide ASTM C 1184 neutral-curing silicone formulation compatible with components with which it contacts, and approved by sealant manufacturer for use in aluminum framing systems indicated.

## 2.8 COMPONENTS

### 2.8.1 Vertical Wall and Window Framing Systems

Provide exterior glazed system at curtain walls and Interior Glazing at windows with provisions for glass replacement. Shop-fabricate and preassembly frame components where possible. Fabricate framing systems with integrally concealed, low conductance thermal barrier, located between exterior materials and exposed interior member to eliminate direct metal-to-metal contact.

### 2.8.2 Sealant and Gaskets

Glazing at purlins head and sill members shall be by silicone sealant. Setting blocks shall be extruded silicone with a minimum durometer of 80.

## 2.9 FABRICATION

Before shipment to the project site, complete fabrication, assembly, finishing, and other work to the greater extent possible. Disassemble components only as necessary for shipment and installation. Comply with AWS recommendations; grind exposed welds smooth and restore mechanical finish. Install reinforcing as necessary for performance requirements, sag resistance and rigidity. Separate dissimilar metals with zinc chromate primer, bituminous paint, or other separator that will prevent corrosion. Maintain accurate relation of planes and angles, with hairline fit of contracting members. Conceal fasteners wherever possible.

## 2.10 FINISHES

Provide clear anodized finish in accordance with AA DAF-45, AA-M12C22A41, for all framing components that are exposed to view.

## PART 3 EXECUTION

### 3.1 INSTALLATION OF VERTICAL WALL AND WINDOW SYSTEMS

#### 3.1.1 Installation

Install framing in accordance with manufacturer's instruction. Install plumb and vertical, within tolerances published by manufacturer. Do not install component parts which are observed to be defective including warped, bowed, dented, abraded and broken members, and including glass with edge damage. Remove and replace members which have been damaged during installation or thereafter before time of acceptance. Manufacturer's installation instructions shall be submitted. Do not cut, trim, weld or braze component parts during erection, in a manner which would damage finish, decrease strength, or result in a visual imperfection or a failure in performance of window wall. Return component parts which require alteration to shop for refabrication, if possible, or for replacement by new parts. Set units plumb, level, and true to line, without warp or rack of framing members, doors, or panels. Provide proper support and anchor securely in place.

#### 3.1.2 Protection of Aluminum

Separate aluminum and other corrodible metal surfaces from source of corrosion of electrolytic action at points of contact with other materials. Comply with requirements specified under paragraph "Dissimilar Materials" in the Appendix to AAMA 101-85.

#### 3.1.3 Sealant and Gaskets

Set sill members and other members in bed of sealant and provide joint fillers or gaskets to provide weathertight construction. Install structural glazing sealant according to sealant manufacturer's instructions.

#### 3.1.4 Glazing

Refer to Section 08810, GLASS AND GLAZING for installation of glass and other panels indicated to be glazed into framing, and not preglazed by

manufacturer.

#### 3.1.5 Cleaning

Clean the completed system, inside and out, promptly after installation, exercising care to avoid damage to coatings. Clean glass surfaces after installation. Remove excess glazing and sealant compounds, dirt and other substances from aluminum surfaces.

#### 3.1.6 Protection

Institute protective measures required throughout the remainder of the construction period to ensure that aluminum vertical wall systems will be without damage or deterioration, other than normal weathering, at time of acceptance.

-- End of Section --

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SECTION 08600

SKYLIGHTS

**08/00**

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## SECTION 08600

## SKYLIGHTS

**08/00**

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)

AAMA 1600/I.S.7 (2000) Voluntary Specification for Skylights

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 1002	(1994) Apparent Shear Strength of Single-Lap-Joint Adhesively Bonded Metal Specimens by Tension Loading (Metal-to-Metal)
ASTM D 1003	(1997) Haze and Luminous Transmittance of Transparent Plastics
ASTM D 1037	(1996a) Evaluating Properties of Wood-Base Fiber and Particle Panel Materials
ASTM D 2244	(2002) Calculation of Color Difference From Instrumentally Measured Color Coordinates.
ASTM D 3841	(1997) Glass-Fiber-Reinforced Polyester Plastic Panels
ASTM E 72	(1998) Conducting Strength Tests of Panels for Building Construction
ASTM E 108	(1996) Fire Tests of Roof Coverings
ASTM E 283	(1991) Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen
ASTM E 331	(1996) Water Penetration of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference

## NATIONAL FENESTRATION RATING COUNCIL (NFRC)

NFRC 100	(1997) Procedure for Determining Fenestration Product U-factors
NFRC 200	(1997) Procedure for Determining Fenestration Product Solar Heat Gain Coefficients at Normal Incidence

## 1.2 GENERAL REQUIREMENTS

The Contractor shall furnish and install commercially available insulated translucent skylights which satisfy all requirements contained in this section and have been verified by load testing and independent design analyses (if required) to meet specified design requirements. The Contractor shall provide environmentally preferable products and work practices, applicable to skylights, considering raw materials acquisition, production, manufacturing, packaging, distribution, reuse, operation, maintenance, and/or disposal of the products or services used in the skylights. The skylight system shall be UV-stabilized, shatter proof and energy efficient. The plastics used in the manufacture of the skylights shall be light transmitting fiberglass reinforced plastics for daylighting applications.

## 1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

### SD-02 Shop Drawings

Shop Drawings; G, AE.

Drawings showing fabrication details, materials, dimensions, installation methods, anchors, and relationship to adjacent construction.

### SD-03 Product Data

Skylights; G, AE.

Manufacturer's descriptive data and catalog cuts.

Warranty; G, AO.

Manufacturer's 5 year complete warranty.

### SD-06 Test Reports

Test Reports.

Certified test reports from independent testing laboratory for each type and class of panel system. Reports shall verify that the material meets specified performance requirements. Previously completed test reports will be acceptable if they are current and indicative of products used on this project. Where a Class A, B or C roof is part of the project, a listing certificate for roof covering systems category shall be provided certifying that the

product complies with the safety standards of ASTM E 108 and the Uniform Building Code.

#### SD-07 Certificates

Skylights; G, AE.

Manufacturer's certificate stating that products meet or exceed specified requirements. Skylight system shall be evaluated and listed (the whole skylight as a unit, not just a glazing material in the unit) by the recognized building code authorities: ICBO and SBCCI-Public Safety Testing and Evaluation Services Inc. Product ratings determined using NFRC 100 and NFRC 200 shall be authorized for certification and properly labeled by the manufacturer.

Qualifications; G, AO.

Documentation of manufacturer's and installer experience indicating compliance with specified requirements.

### 1.4 QUALIFICATIONS

The manufacturer shall be a company specializing in the manufacture of the specified products with a minimum of 5 years documented experience. The installer shall have documented experience of 5 years minimum performing the work specified.

### 1.5 DELIVERY STORAGE AND HANDLING

System modules shall be factory assembled to the greatest extent possible. Panels shall be shipped to the jobsite in rugged shipping units and shall be ready for erection. All skylights shall have conspicuous decals affixed warning individuals against sitting or stepping on the units. Skylight panels shall be stored on the long edge, several mm above the ground, blocked and under cover to prevent warping. Unit skylights shall be delivered in manufacturer's original containers, dry, undamaged, with seals and labels intact. All products shall be delivered, stored and protected in accordance with manufacturer's recommendations.

### 1.6 WARRANTY

The Contractor shall provide to the Government the manufacturer's complete warranty for materials, workmanship, and installation. The warranty shall be for 5 years from the time of project completion and shall not be prorated. The warranty shall guarantee, but shall not be limited to, the following:

- a. Light transmission and color of the panels shall not change more than 3.0 Hunter Units per ASTM D 2244 after 5-year exposure.
- b. There is no delamination of the panel affecting appearance, performance, weatherability or structural integrity of the panels or the completed system.
- c. There is no fiberbloom on the panel face.
- d. Change in light transmission of no more than 6% per ASTM D 1003, and in color (yellowing index) no more than 10 points in comparison to the original specified value over a 10 year period.



## PART 2 PRODUCTS

### 2.1 SKYLIGHT PANELS

Translucent Skylight faces shall be fabricated of glass-fiber reinforced thermoset resins. Size of panels shall be as indicated. Exterior faces shall be 1.8 mm (0.07 inch) thick. Interior faces shall be 1.14 mm (0.045 inch) thick.

### 2.2 GLASS-FIBER PANELS

Glass-fiber reinforced polyester panels shall conform to ASTM D 3841, Class CC-2 for exterior face and Class CC-1 for interior face and to the requirements of AAMA 1600/I.S.7.

#### 2.2.1 Weatherability

The exposed faces of fiberglass sandwich type panels shall have a permanent glass veil erosion barrier embedded integrally to provide maximum long term resistance to reinforcing fiber exposure. The exterior face sheet shall be uniform in strength and be resistant to penetration by pencil point.

#### 2.2.2 Non Combustible Grid Core

The aluminum I-beams shall be 6063-T6 with provisions for mechanical interlocking of muntin-mullion and perimeter to prevent high and low intersections which do not allow full bonding surface to contact with face material. Width of I-beam shall be no less than 11 mm. I-beam grid shall be machined to tolerances of not greater than plus or minus 0.05 mm for flat panels. Panels shall withstand 650 degrees C fire for a minimum of one hour without collapse or exterior flaming.

#### 2.2.3 Adhesive

The laminate adhesive shall be heat and pressure resin-type engineered for structural sandwich panel use. Adhesive shall pass testing requirements specified by the International Conference of Building Officials' "Acceptance Criteria for Sandwich Panel Adhesive". Minimum strength shall be:

- a. Tensile Strength of 5.2 MPa in accordance with ASTM C 297 after two exposures to six cycles each of the aging conditions prescribed in ASTM D 1037.
- b. Shear Strength, after exposure to five separate aging conditions in accordance with ASTM D 1002, shall be:
  - (1) 3.7 MPa at 50% relative humidity and 23 degrees C.
  - (2) 5.5 MPa under accelerated aging per ASTM D 1037 at room temperature.
  - (3) 1.7 MPa under accelerated aging per ASTM D 1037 at 83 degrees C.
  - (4) 9.7 MPa after 500 hour Oxygen Bomb per ASTM D 572.
  - (5) 690 kPa at 83 degrees C.

#### 2.2.4 Panel Construction

Panels shall consist of fiberglass faces laminated to an aluminum I-beam grid core and shall deflect no more than 48 mm at 147 kg per square meter in 3 m per ASTM E 72, without a supporting frame. Quality control inspections and required testing, conducted at least once each year, shall include manufacturing facilities, sandwich panel components and production sandwich panels for conformance with "Acceptance Criteria for Sandwich Panels" as regulated by the ICBO-ES or equivalent.

### 2.3 COMMON PANEL REQUIREMENTS

#### 2.3.1 Appearance

The face sheets shall be uniform in color to prevent splotchy appearance. Faces shall be completely free of ridges and wrinkles which prevent proper surface contact. Clusters of air bubbles/pinholes which collect moisture and dirt are not acceptable.

#### 2.3.2 Panel Fabrication

Panel construction shall meet the following requirements: Light transmission 8 %; color white.

#### 2.3.3 Thermal Performance

Thermal transmittance for skylights with insulating glass shall not exceed a U-factor of 0.14 Btu/hr-ft<sup>2</sup>-F when determined using NFRC 100, and a SHGC of 0.09 BTU/HR-ft<sup>2</sup>-F when determined using NFRC 200.

#### 2.3.4 Condensation Index Rating

The condensation index rating shall be 80 as determined using National Fenestration Rating Council approved software THERM.

### 2.4 SKYLIGHT SYSTEMS

The skylight systems shall meet the following requirements:

- a. Integral perimeter framing system assembly shall be by the manufacturer.
- b. Exterior panel faces shall be white in color. Interior panel faces shall be white in color. Skylight trim shall be white.
- c. Air infiltration at 300 Pa shall be less than 0.5 L/s/m<sup>2</sup> in accordance with ASTM E 283.
- d. Water penetration at test pressure of 73 kg/m<sup>2</sup> shall be zero in accordance with ASTM E 331.
- e. Manufacturer shall be responsible for maximum system deflection, in accordance with the applicable building code, and without damage to system performance. Deflection shall be calculated in accordance with engineering principles.
- f. Proper weepage elements shall be incorporated within the

perimeter framework of the glazing system for drainage of any condensation or water penetration.

g. System shall accommodate movement within the system; movement between the system and perimeter framing components; dynamic loading and release of loads; and deflection of supporting members. This shall be achieved without damage to system or components, deterioration of weather seals and fenestration properties specified.

h. The exterior panel face shall repel an impact of 81 N-m without fracture or tear when impacted by a 89 mm diameter, 2.9 kg free falling ball. Impact strength shall be measured by the Society of Plastics Industries (SPI) method.

i. Exposed aluminum color shall be selected from the manufacturer's standard range. Corrosion resistant finish shall be oven dried Kynar 500, two coats.

j. The system shall require no scheduled recoating to maintain its performance or for UV resistance.

k. Design criteria shall be: Wind Load and snow load as indicated.

l. Extruded aluminum shall be 6063-T6 and 6063-T5; all fasteners shall be stainless steel or cadmium plated steel.

## 2.5 FLEXIBLE SEALING TAPE

Sealing tape shall be manufacturer's standard pre-applied to closure system at the factory under controlled conditions.

## PART 3 EXECUTION

### 3.1 PREPARATION

The Contractor shall verify when structural support is ready to receive all specified work and to convene a pre-installation conference, if approved by the Contracting Officer, including the Contractor, skylight installer and all parties directly affecting and affected by the specified work. All submitted opening sizes, dimensions and tolerances shall be field verified; preparation of openings shall include isolating dissimilar materials from aluminum system to avoid damage by electrolysis. The installer shall examine area of installation to verify readiness of site conditions and to notify the Contractor about any defects requiring correction. Work shall not commence until conditions are satisfactory.

### 3.2 ERECTION

Translucent skylight system shall be erected in accordance with the approved shop drawings supplied by the manufacturer. Fastening and sealing shall be in accordance with the manufacturer's shop drawings. All panel protection shall be removed and, after other trades have completed work on adjacent materials, panel installation shall be carefully inspected and adjusted, if necessary, to ensure proper installation and weather-tight conditions. All staging, lifts and hoists required for the complete installation and field measuring shall be provided. System shall be installed clean of dirt, debris or staining and thoroughly examined for removal of all protective material prior to final inspection of the

designated work area.

### 3.2.1 Installation

Flash and counter flash skylights to curbs in accordance with manufacturer's instructions. Install skylight counter-flashing with uniformly sized and spaced joints. completely cover curb flashing with metal counter flashing. Irregular or large gaps excepting 12 mm filled with sealant will not be acceptable.

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## DIVISION 08 - DOORS &amp; WINDOWS

## SECTION 08710

## DOOR HARDWARE

**02/02**

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## SECTION 08710

## DOOR HARDWARE

**02/02**

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM E 283	(1991) Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen
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## BUILDERS HARDWARE MANUFACTURERS ASSOCIATION (BHMA)

BHMA A156.1	(1997) Butts and Hinges (BHMA 101)
BHMA A156.2	(1996) Bored and Preamsembled Locks and Latches (BHMA 601)
BHMA A156.3	(1994) Exit Devices (BHMA 701)
BHMA A156.4	(1992) Door Controls - Closers (BHMA 301)
BHMA A156.5	(1992) Auxiliary Locks & Associated Products (BHMA 501)
BHMA A156.7	(1988) Template Hinge Dimensions
BHMA A156.13	(1994) Mortise Locks & Latches (BHMA 621)
BHMA A156.15	(1995) Closer Holder Release Devices
BHMA A156.16	(1997) Auxiliary Hardware
BHMA A156.18	(1993) Materials and Finishes (BHMA 1301)
BHMA A156.21	(1996) Thresholds
BHMA A156.22	(1996) Door Gasketing Systems

## NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 80	(1999) Fire Doors and Fire Windows
NFPA 101	(1997) Life Safety Code

## UNDERWRITERS LABORATORIES (UL)

UL Bld Mat Dir	(1999) Building Materials Directory
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## 1.2 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures."

## SD-02 Shop Drawings

Hardware schedule; G, AE.

Keying system

## SD-03 Product Data

Hardware items; G, AE.

## SD-08 Manufacturer's Instructions

Installation

## SD-10 Operation and Maintenance Data

Hardware Schedule items, Data Package 1; G, AO.

Submit data package in accordance with Section 01781, "Operation and Maintenance Data."

## SD-11 Closeout Submittals

Key bitting

## 1.3 HARDWARE SCHEDULE

Prepare and submit hardware schedule in the following form:

Hard- ware Item	Quan- tity	Size	Reference Publi- cation Type No.	Finish	Mfr. Name and Catalog No.	Key Con- trol Symbols	UL Mark (If fire rated and listed)	BHMA Finish Designa- tion
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## 1.4 KEY BITTING CHART REQUIREMENTS

Submit key bitting charts to the Contracting Officer prior to completion of the work. Include:

- Complete listing of all keys (AA1, AA2, etc.).
- Complete listing of all key cuts (AA1-123456, AA2-123458).
- Tabulation showing which key fits which door.
- Copy of floor plan showing doors and door numbers.
- Listing of 20 percent more key cuts than are presently required in each master system.



## 1.5 QUALITY ASSURANCE

### 1.5.1 Hardware Manufacturers and Modifications

Provide, as far as feasible, locks, hinges, pivots, and closers of one lock, hinge, pivot, or closer manufacturer's make. Modify hardware as necessary to provide features indicated or specified.

## 1.6 DELIVERY, STORAGE, AND HANDLING

Deliver hardware in original individual containers, complete with necessary appurtenances including fasteners and instructions. Mark each individual container with item number as shown in hardware schedule. Deliver permanent keys and removable cores to the Contracting Officer, either directly or by certified mail. Deliver construction master keys with the locks.

## 1.7 COORDINATION

Hardware for acoustically rated doors specified in Section 08385 SOUND RETARDANT SWINGING DOORS shall be installed by door manufacturer.

## PART 2 PRODUCTS

### 2.1 TEMPLATE HARDWARE

Hardware to be applied to metal or to prefinished doors shall be made to template. Promptly furnish template information or templates to door and frame manufacturers. Template hinges shall conform to BHMA A156.7. Coordinate hardware items to prevent interference with other hardware.

### 2.2 HARDWARE FOR FIRE DOORS AND EXIT DOORS

Provide all hardware necessary to meet the requirements of NFPA 80 for fire doors and NFPA 101 for exit doors, as well as to other requirements specified, even if such hardware is not specifically mentioned under paragraph entitled "Hardware Schedule." Such hardware shall bear the label of Underwriters Laboratories, Inc., and be listed in UL Bld Mat Dir or labeled and listed by another testing laboratory acceptable to the Contracting Officer.

### 2.3 HARDWARE ITEMS

Hinges, pivots, locks, latches, exit devices, bolts, and closers shall be clearly and permanently marked with the manufacturer's name or trademark where it will be visible after the item is installed. For closers with covers, the name or trademark may be beneath the cover.

#### 2.3.1 Hinges

BHMA A156.1, 114 by 114 millimeters unless otherwise specified. Construct loose pin hinges for exterior doors and reverse-bevel interior doors so that pins will be nonremovable when door is closed. Other antifriction bearing hinges may be provided in lieu of ball-bearing hinges.

#### 2.3.2 Pivots

BHMA A156.4.

### 2.3.3 Locks and Latches

#### 2.3.3.1 Mortise Locks and Latches

BHMA A156.13, Series 1000, Operational Grade 1, Security Grade 2. Knobs and roses of mortise locks shall have screwless shanks and no exposed screws.

#### 2.3.3.2 Bored Locks and Latches

BHMA A156.2, Series 4000, Grade 1.

#### 2.3.3.3 Auxiliary Locks

BHMA A156.5, Grade 1.

#### 2.3.3.4 Combination Locks

High security electro-mechanical combination locks with interior thumb-turn to release latch. Provide KABA-MAS X-09 or equal.

#### 2.3.3.5 Cipher Lockets

Heavy-duty, mechanical combination lockset with five pushbuttons, standard-sized levers, 20 mm deadlocking latch, 70 mm backset. Lock shall be operated by pressing two or more of the buttons in unison or individually in the proper sequence. Inside lever shall always operate the latch. Provide a keyed cylinder on the interior to permit setting the combination. Provide a thumb turn on the interior to activate passage set function, so that outside knob operates latch without using the combination.

### 2.3.4 Exit Devices

BHMA A156.3, Grade 1. Provide adjustable strikes for rim type and vertical rod devices. Provide open back strikes for pairs of doors with mortise and vertical rod devices. Touch bars may be provided in lieu of conventional crossbars and arms.

### 2.3.5 Exit Locks With Alarm

BHMA A156.5, Type E0431 (with full-width horizontal actuating bar) for single doors. Provide terminals for connection to remote indicating panel.

### 2.3.6 Cylinders and Cores

Provide cylinders and cores for new locks, including locks provided under other sections of this specification. Cylinders and cores shall have six pin tumblers. Cylinders shall be products of one manufacturer, and cores shall be the products of one manufacturer. Rim cylinders, mortise cylinders, and knobs of bored locksets shall have interchangeable cores which are removable by special control keys. Stamp each interchangeable core with a key control symbol in a concealed place on the core.

### 2.3.7 Keying System

Provide an extension of the existing keying system. Existing locks were manufactured by Schlage and have interchangeable cores. Provide construction interchangeable cores.

### 2.3.8 Lock Trim

Cast, forged, or heavy wrought construction and commercial plain design.

#### 2.3.8.1 Lever Handles

Provide lever handles in lieu of knobs. Lever handles for exit devices shall meet the test requirements of BHMA A156.13 for mortise locks. Lever handle locks shall have a breakaway feature (such as a weakened spindle or a shear key) to prevent irreparable damage to the lock when a force in excess of that specified in BHMA A156.13 is applied to the lever handle. Lever handles shall return to within 13 mm of the door face.

#### 2.3.8.2 Texture

Provide knurled or abrasive lever handles for doors to mechanical and electrical rooms.

### 2.3.9 Keys

Furnish one file key, one duplicate key, and one working key for each lock and for each master and grand master keying system. Furnish one additional working key for each lock of each keyed-alike group. Furnish a quantity of key blanks equal to 20 percent of the total number of file keys. Stamp each key with appropriate key control symbol and "U.S. property - Do not duplicate." Do not place room number on keys.

### 2.3.10 Door Bolts

BHMA A156.16. Provide dustproof strikes for bottom bolts, except for doors having metal thresholds. Automatic latching flush bolts: BHMA A156.3, Type 25.

### 2.3.11 Closers

BHMA A156.4, Series C02000, Grade 1, with PT 4C. Provide with brackets, arms, mounting devices, fasteners, full size covers, except at storefront mounting, and other features necessary for the particular application. Size closers in accordance with manufacturer's recommendations, or provide multi-size closers, Sizes 1 through 6, and list sizes in the Hardware Schedule. Provide manufacturer's 10 year warranty.

#### 2.3.11.1 Identification Marking

Engrave each closer with manufacturer's name or trademark, date of manufacture, and manufacturer's size designation located to be visible after installation.

### 2.3.12 Closer Holder-Release Devices

BHMA A156.15.

### 2.3.13 Door Protection Plates

#### 2.3.13.1 Sizes of Kick Plates

Width for single doors shall be 50 mm less than door width; width for pairs of doors shall be 25 mm less than door width. Height of kick plates shall be 200 mm for flush doors.

#### 2.3.14 Door Stops and Silencers

BHMA A156.16. Silencers Type L03011. Provide three silencers for each single door, two for each pair.

#### 2.3.15 Thresholds

BHMA A156.21.

#### 2.3.16 Weather Stripping Gasketing

BHMA A156.22. Provide the type and function designation where specified in paragraph entitled "Hardware Schedule". A set shall include head and jamb seals and, for pairs of doors, astragals. Air leakage of weather stripped doors shall not exceed  $2.19 \times 10^{-5}$  cms per minute of air per square meter of door area when tested in accordance with ASTM E 283. Weather stripping shall be one of the following:

##### 2.3.16.1 Extruded Aluminum Retainers

Extruded aluminum retainers not less than 1.25 mm wall thickness with vinyl, neoprene, silicone rubber, or polyurethane inserts. Aluminum shall be clear (natural) anodized, or site painted as scheduled.

#### 2.3.17 Rain Drips

Extruded aluminum, not less than 2.03 mm thick, clear anodized. Set drips in sealant conforming to Section 07900, "Joint Sealing," and fasten with stainless steel screws.

##### 2.3.17.1 Door Rain Drips

Approximately 38 mm high by 16 mm projection. Align bottom with bottom edge of door.

#### 2.3.18 Special Tools

Provide special tools, such as spanner and socket wrenches and dogging keys, required to service and adjust hardware items.

### 2.4 FASTENERS

Provide fasteners of proper type, quality, size, quantity, and finish with hardware. Fasteners exposed to weather shall be of nonferrous metal or stainless steel. Provide fasteners of type necessary to accomplish a permanent installation.

### 2.5 FINISHES

Conform to BHMA A156.18. Provide finishes as scheduled.

### 2.6 KEY CABINET AND CONTROL SYSTEM

BHMA A156.5. Type required to yield a capacity (number of hooks) 50 percent greater than the number of key changes used for door locks.

## PART 3 EXECUTION

### 3.1 INSTALLATION

Install hardware in accordance with manufacturers' printed instructions. Fasten hardware to wood surfaces with full-threaded wood screws or sheet metal screws. Provide machine screws set in expansion shields for fastening hardware to solid concrete and masonry surfaces. Provide toggle bolts where required for fastening to hollow core construction. Provide through bolts where necessary for satisfactory installation.

#### 3.1.1 Weather Stripping Installation

Handle and install weather stripping so as to prevent damage. Provide full contact, weather-tight seals. Doors shall operate without binding.

##### 3.1.1.1 Stop-Applied Weather Stripping

Fasten in place with color-matched sheet metal screws not more than 225 mm o.c. after doors and frames have been finish painted.

#### 3.1.2 Threshold Installation

Extend thresholds the full width of the opening and notch end for jamb stops. Set thresholds in a full bed of sealant and anchor to floor with cadmium-plated, countersunk, steel screws in expansion sleeves.

### 3.2 FIRE DOORS AND EXIT DOORS

Install hardware in accordance with NFPA 80 for fire doors, NFPA 101 for exit doors.

### 3.3 DOORS WITH ACOUSTIC RATING

Conform to requirements of door manufacturer when installing hardware on sound retardant doors. Do not compromise acoustical performance of door.

### 3.4 HARDWARE LOCATIONS

SDI 100, unless indicated or specified otherwise.

- a. Kick and Armor Plates: Push side of single-acting doors.
- b. Balance magnetic switches: On secure side of doors.

### 3.5 KEY CABINET AND CONTROL SYSTEM

Locate where directed by the Contracting Officer. Tag one set of file keys and one set of duplicate keys. Place other keys in appropriately marked envelopes, or tag each key. Furnish complete instructions for setup and use of key control system. On tags and envelopes, indicate door and room numbers or master or grand master key.

### 3.6 FIELD QUALITY CONTROL

After installation, protect hardware from paint, stains, blemishes, and other damage until acceptance of work. Submit notice of testing 15 days before scheduled, so that testing can be witnessed by the Contracting Officer. Adjust hinges, locks, latches, bolts, holders, closers, and other items to operate properly. Demonstrate that permanent keys operate respective locks, and give keys to the Contracting Officer. Correct,

repair, and finish, as directed, errors in cutting and fitting and damage to adjoining work.

### 3.7 HARDWARE SETS

#### Hardware Set 1:

- 6 Hinges, A51111, NRP, Finish 630
- 2 Rim Type Exit Devices, Type 1, Function 03, Finish 626
- 1 Removable Aluminum Mullion, Finish 628
- 2 Outside Trim Pull Handle, J402, Finish 626
- 1 Cylinder, Finish 625
- 2 Closers, C02021, Size IV, PT4C, PT4G, Finish 689
- 2 Weatherstrip Sets, R3F165, Flange Finish 628
  - Threshold, J32139, Finish 719
- 2 Door Bottoms, R0Y425
- 1 Balanced Magnetic Switch

All hardware supplied by door manufacturer

#### Hardware Set 2:

- 6 Hinges, A51111, NRP, Finish 630
- 1 Rim Type Exit Device, Type 1, Function 08, Finish 626 or 630
- 1 Rim Type Exit Device, Type 1, Function 01, Finish 626 or 630
- 1 Removable Steel Mullion, Finish 600
- 1 Outside Trim Lever, Finish 630
- 2 Closers, C02021, Size IV, PT4C, PT4G, Finish 689
- 2 Weatherstrip Sets, R3F165, Flange Finish 600
- 2 Thresholds, J32139, Finish 719
- 2 Door Bottoms, R0Y415

#### Hardware Set 3:

- 6 Hinges, A81111, Finish 626
- 1 Latch Set, Function F75, Finish 630
- 1 Closer, C02011, Size III, PT4C, Finish 689
- 2 Flush Bolts, L04251, Finish 626
- 1 Dust-Proof Strike, L04021, Finish 626

Smoke Gasket Set, R0Y154

#### Hardware Set 4:

- 3 Cam Lift Hinges, Finish 626
- 1 Combination Lock, Kaba-Ilco X09
- 1 Cipher Lock, Kaba-Ilco Simplex 5000, Finish 630
- 1 Closer, C02011, Size IV, PT4C, Finish 689
- 2 Sets Magnetic Sound Seals, R0Y454
- 1 Door Bottom Seal, R0Y414
- 1 Threshold, J37430, Finish 719
- 1 Balanced Magnetic Switch

Provide 1 Wall Stop at Set 4A, L02251, Finish 626

All hardware supplied, installed, and tested by door manufacturer

#### Hardware Set 5:

- 3 Hinges, A81111, Finish 626
- 1 Lock Set, Function F82, Finish 626
- 1 Wall Stop, L02251, Finish 626

#### Hardware Set 6:

- 3 Hinges, A81111, Finish 626
- 1 Closer, C02011, Size III, PT4C, Finish 689

1 Cipher Lock Set, Kaba-Ilco Simplex 5000, Finish 630  
1 Kick Plate, J102, Finish 630  
At Set 6A, add 1 Wall Stop, L02251, Finish 626

## Hardware Set 6B:

3 Hinges, A8111, NRP, Finish 626  
1 Closer, C02021, Size III, PT4C, Finish 689  
1 Cipher Lock Set, Kaba-Ilco Simplex 5000, Finish 630  
1 Kick Plate, J102, Finish 630  
1 Wall Stop, L02251, Finish 626

## Hardware Set 7:

3 Hinges, A8111, Finish 626  
1 Closer, C02011, Size III, PT4C, Finish 689  
1 Latch Set, Function F75, Finish 630  
1 Smoke Gasket Set, R0Y154  
1 Wall Stop, L02251, Finish 626  
1 Kick Plate, J102, Finish 630

## Hardware Set 8:

3 Hinges, A8111, Finish 626  
1 Closer, C02021, Size III, PT4C, Finish 689  
1 Cipher Lock Set, Kaba-Ilco Simplex 5000, Finish 630  
1 Balanced Magnetic Switch

## Hardware Set 9:

3 Hinges, A8111, Finish 626  
1 Closer, C02011, Size III, PT4C, Finish 689  
1 Lock Set, Function F84, Finish 626  
1 Wall Stop, L02251, Finish 626

## Hardware Set 9A:

3 Hinges, A8111, Finish 626  
1 Closer, C02021, Size III, PT4C, Finish 689  
1 Lock Set, Function F84, Finish 626  
1 Wall Stop, L02251, Finish 626

## Hardware Set 10:

3 Hinges, A8111, Finish 626  
1 Closer, C02011, Size III, PT4C, Finish 689  
1 Push Plate, J301, Finish 630  
1 Pull Handle, J405, Finish 630  
1 Kick Plate, J102, Finish 630  
1 Wall Stop, L02251, Finish 626

## Hardware Set 11:

6 Hinges, A8111, Finish 626  
2 Closers, C02011, Size III, PT4C, Finish 689  
1 Latch Set, Function F75, Finish 626  
1 Coordinator, Overhead stop-mounted, Full-width Channel style, with  
concealed lever and trigger mechanism, Finish 626  
1 Astragal, 11 Gage Steel Tee, Finish 600, Site Paint  
2 Electromagnet Door Holders, C00011, Finish 626  
1 Power Supply  
1 Set Smoke Gaskets, R0Y154

## Hardware Set 12:

3 Hinges, A8111, Finish 626  
1 Closer, C02011, Size III, PT4C, Finish 689

- 1 Lock Set, Function F86, Finish 626
- 1 Set Smoke Gaskets, R0Y154
- 1 Wall Stop, L02251, Finish 626

## Hardware Set 12A:

- 3 Hinges, A8111, Finish 626
- 1 Closer, C02021, Size III, PT4C, Finish 689
- 1 Lock Set, Function F86, Finish 626
- 1 Set Smoke Gaskets, R0Y154
- 1 Wall Stop, L02251, Finish 626

## Hardware Set 13:

- 3 Cam Lift Hinges, NRP, Finish 626
- 1 Exit Device, Type 1, Function 01, Finish 626
- 1 Closer, C02011, Size IV, PT4C, Finish 689
- 2 Sets Magnetic Sound Seals, R0Y454
- 1 Door Bottom Seal, R0Y414
- 1 Threshold, J37430, Finish 719
- 1 Balanced Magnetic Switch
- 1 Rain Drip

All hardware supplied, installed, and tested by door manufacturer

## Hardware Set 14:

- 3 Hinges, A8111, NRP, Finish 626
- 1 Closer, C02011, Size III, PT4C, Finish 689
- 1 Exit Device, Type 1, Function 03, Finish 626
- 1 Set Smoke Gaskets, R0Y154
- 1 Balanced Magnetic Switch

## Hardware Set 15:

- 6 Hinges, A5111, NRP, Finish 630
- 2 Lock Sets, Function F86, Finish 626
- 1 Removable Steel Mullion, Finish 600
- 2 Closers, C02011, Size III, PT4C, Finish 689
  - Weatherstrip Set, R3F165, Flange Finish 600, Site Paint
  - Threshold, J32139, Finish 719
- 2 Door Bottoms with Rain Drip, R0Y535, Finish 600, Site Paint

## Hardware Set 16:

- 3 Cam Lift Hinges, NRP, Finish 626
- 1 Exit Device Type 1, Function 01, Finish 626
- 1 Closer, C02021, Size IV, PT4C, Finish 689
- 2 Sets Magnetic Sound Seals, R0Y454
- 1 Door Bottom Seal, R0Y414
- 1 Threshold, J37430, Finish 719
- 1 Balanced Magnetic Switch
- 1 Wall Stop, L02251, Finish 626

All hardware supplied, installed, and tested by door manufacturer

## Hardware Set 17:

- 3 Hinges, A5111, NRP, Finish 630
- 1 Exit Device, Type 1, Function 03
- 1 Outside Trim Lever, Finish 630
- 1 Closer, C02021, Size IV, PT4C, Finish 689
- 1 Weatherstrip Set, R3F165, Flange Finish 600, Site Paint
- 1 Threshold, J32139, Finish 719
- 1 Balanced Magnetic Switch

## Hardware Set 18:



3 Hinges, A5111, NRP, Finish 630  
1 Exit Devices, Type 1, Function 03, Finish 626  
1 Outside Trim Lever, Finish 626  
1 Closer, C02021, Size IV, PT4C, Finish 689  
1 Weatherstrip Set, R3F165, Flange Finish 600, Site Paint  
1 Threshold, J32139, Finish 719  
1 Door Bottom, R0Y425  
All hardware supplied by door manufacturer

## Hardware Set 19:

3 Hinges, A8111, NRP, Finish 626  
1 Closer, C02021, Size IV, PT4C, Finish 689  
1 Exit Device, Type 1, Function 03, Finish 626  
1 Outside Trim Lever, Finish 626  
1 Set Smoke Gaskets, R0Y154  
1 Wall Stop, L02251, Finish 626  
1 Kick Plate, J102, Finish 630

## Hardware Set 20:

3 Hinges, A8111, NRP, Finish 626  
1 Latch Set, Function F75, Finish 626  
1 Wall Stop, L02251, Finish 626  
1 Kick Plate, J102, Finish 630

## Hardware Set 21:

6 Cam Lift Hinges, Finish 626  
1 Combination Lock, Kaba-Ilco X09  
1 Cipher Lock Set, Kaba-Ilco Simplex 5000, Finish 630  
1 Closer, C02011, Size IV, PT4C, Finish 689  
2 Surface Bolts, L04161, Finish 626  
2 Sets Magnetic Sound Seals, R0Y454  
2 Door Bottom Seals, R0Y414  
1 Threshold, J37430, Finish 719  
1 Balanced Magnetic Switch  
All hardware supplied, installed, and tested by door manufacturer

## Hardware Set 22:

3 Hinges, A5111, NRP, Finish 630  
1 Lockset, Function F86, Finish 626  
1 Closer, C02011, Size IV, PT4C, Finish 689  
1 Weatherstrip Set, R3F165, Flange Finish 600  
1 Threshold, J32139, Finish 719  
1 Door Bottom with Rain Drip, R0Y535, Finish 600  
1 Balanced Magnetic Switch

## Hardware Set 23:

3 Hinges, A8111, Finish 626  
1 Closer, C02011, Size III, PT4C, Finish 689  
1 Cipher Lock Set, Kaba-Ilco Simplex 5000, Finish 630  
1 Set Smoke Gaskets, R0Y154  
1 Wall Stop, L02251, Finish 626  
1 Balanced Magnetic Switch

## Hardware Set 24:

3 Hinges, A5111, NRP, Finish 630  
1 Exit Device, Type 1, Function 01  
1 Closer, C02021, Size IV, PT4C, Finish 689  
1 Weatherstrip Set, R3F165, Flange Finish 600  
1 Threshold, J32139, Finish 719

1 Door Bottom with Rain Drip, R0Y535, Finish 600  
1 Balanced Magnetic Switch

## Hardware Set 25:

6 Hinges, A8111, Finish 626  
2 Closers, C02011, Size III, PT4C, Finish 689  
2 Exit Devices, Type 2, Function 01  
1 Set Smoke Gaskets, R0Y154  
2 Electromagnetic Door Holders, C00011, Finish 626  
1 Astragal, 11 Gage Steel Tee, Finish 600  
2 Dust-Proof Floor Strikes, L04021, Finish 626

## Hardware Set 26:

3 Hinges, A8111, Finish 626  
2 Closers, C02021, Size III, PT4C, Finish 689  
1 Exit Device, Type 1, Function 11  
1 Outside Lever Trim, Finish 626  
1 Set Smoke Gaskets, R0Y154

## Hardware Set 27:

3 Hinges, A8111, Finish 626  
1 Closer, C02011, Size III, PT4C, Finish 689  
1 Latch Set, Function F75, Finish 626  
1 Set Smoke Gaskets, R0Y154  
1 Electromagnetic Door Holder, C00011, Finish 626

## Hardware Set 28:

6 Hinges, A8111, Finish 626  
1 Lock Set, Function F84, Finish 626  
2 Automatic Flush Bolts, Finish 626  
1 Dust-Proof Floor Strike, L04021, Finish 626  
2 Floor Stop-Holders, L01371, Finish 626

## Hardware Set 29:

3 Hinges, A8111, Finish 626  
1 Closer, C02011, Size III, PT4C, Finish 689  
1 Latch Set, Function F75, Finish 626  
1 Set Smoke Gaskets, R0Y154  
1 Wall Stop, L02251, Finish 626  
1 Electromagnetic Door Holder, C00011, Finish 626  
1 Kick Plate, J102, Finish 630

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## DIVISION 08 - DOORS &amp; WINDOWS

## SECTION 08810

## GLASS AND GLAZING

**05/97**

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## SECTION 08810

GLASS AND GLAZING  
05/97

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z97.1	(1984; R 1994) Safety Performance Specifications and Methods of Test for Safety Glazing Materials Used in Buildings
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## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 509	(1994) Elastomeric Cellular Preformed Gasket and Sealing Material
ASTM C 864	(1999) Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers
ASTM C 920	(1998) Elastomeric Joint Sealants
ASTM C 1036	(1991; R 1997) Flat Glass
ASTM C 1048	(1997b) Heat-Treated Flat Glass - Kind HS, Kind FT Coated and Uncoated Glass
ASTM C 1172	(1996el) Laminated Architectural Flat Glass
ASTM D 395	(1998) Rubber Property - Compression Set
ASTM E 773	(1997) Accelerated Weathering of Sealed Insulating Glass Units
ASTM E 774	(1997) Classification of the Durability of Sealed Insulating Glass Units
ASTM E 1300	(1998) Determining the Minimum Thickness and Type of Glass Required to Resist a Specified Load

## GLASS ASSOCIATION OF NORTH AMERICA (GANA)

GANA Glazing Manual	(1997) Glazing Manual
GANA Standards Manual	(1995) Engineering Standards Manual

## 1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

#### SD-02 Shop Drawings

Installation; G, AE.

Drawings showing complete details of the proposed setting methods, mullion details, edge blocking, size of openings, frame details, materials, and types and thickness of glass.

#### SD-03 Product Data

Insulating Glass; G, AE.  
Glazing Accessories.

Manufacturer's descriptive product data, handling and storage recommendations, installation instructions, and cleaning instructions.

#### SD-04 Samples

Insulating Glass; G, AE.

Two 203 x 254 mm samples of each of the following: insulating glass units.

#### SD-07 Certificates

Insulating Glass; G, AE.

Certificates stating that the glass meets the specified requirements. Labels or manufacturers marking affixed to the glass will be accepted in lieu of certificates.

### 1.3 SYSTEM DESCRIPTION

Glazing systems shall be fabricated and installed watertight and airtight to withstand thermal movement and wind loading without glass breakage, gasket failure, deterioration of glazing accessories, and defects in the work. Glazed panels shall comply with the safety standards, as indicated in accordance with ANSI Z97.1. Glazed panels shall comply with indicated wind loading in accordance with ASTM E 1300.

### 1.4 DELIVERY, STORAGE AND HANDLING

Glazing compounds shall be delivered to the site in the manufacturer's unopened containers. Glass shall be stored indoors in a safe, well ventilated dry location in accordance with manufacturer's instructions, and shall not be unpacked until needed for installation. Glass shall not be stored on site over 1 month.

### 1.5 PROJECT/SITE CONDITIONS

Glazing work shall not be started until outdoor temperature is above 5

degrees C and rising, unless procedures recommended by glass manufacturer and approved by Contracting Officer are made to warm the glass and rabbet surfaces. Ventilation shall be provided to prevent condensation of moisture on glazing work during installation. Glazing work shall not be performed during damp or raining weather.

## 1.6 WARRANTY

### 1.6.1 Insulating Glass

Manufacturer shall warrant the insulating glass to be free of fogging or film formation on the internal glass surfaces caused by failure of the hermetic seal for a period of 10 years from Date of Substantial Completion. Warranty shall be signed by manufacturer.

### 1.6.2 Monolithic Reflective Glass

Manufacturer shall warrant the monolithic reflective glass to be free of peeling or deteriorating of coating for a period of 10 years after Date of Substantial Completion. Warranty shall be signed by manufacturer.

### 1.6.3 Monolithic Opacified Spandrel

Manufacturer shall warrant the opacifier film on the spandrel to be free of peeling for a period of five years after Date of Substantial Completion. Warranty shall be signed by manufacturer.

## PART 2 PRODUCTS

### 2.1 FLOAT GLASS

#### 2.1.1 Annealed Glass

Annealed glass shall be Type I transparent flat type, Class 1 - tinted, Quality q3 - glazing select, conforming to ASTM C 1036. Color shall match glass in existing building: outer pane P.P.G. Azurlite, inner pane P.P.G. Sungate 100(3).

### 2.2 INSULATING GLASS

Insulating glass shall be Class A preassembled units of dual-seal construction consisting of lites of glass separated by an aluminum, steel, or stainless steel, spacer and dehydrated space conforming to ASTM E 773 and ASTM E 774. Spacer shall be roll-formed, with bent or tightly welded or keyed and sealed joints to completely seal the spacer periphery and eliminate moisture and hydrocarbon vapor transmission into airspace through the corners. Primary seal shall be compressed polyisobutylene and the secondary seal shall be a specially formulated silicone. Glass types shall be as follows:

#### 2.2.1 Clear Insulating Glass

Insulating Glass shall be composed of the following 3 layers:

- a. Outer Pane: 6 mm Thickness annealed glass with spectrally selective tinting in azure-blue color, and low-emissivity coating on inner surface (#2 surface). At locations where fully-tempered glass is required, substitute fully-tempered glass for annealed glass, with same tinting and coating.

- b. 12 mm air layer.
- c. Inner Pane: Laminated glass composed of 2 - 3 mm layers clear annealed glass bonded together with 0.75 mm polyvinyl-butaryl (PVB) layer, conforming to ASTM C 1172.
- d. Insulating Glass Performance: 53-percent visible light transmittance, 0.29 winter nighttime V-value, 0.35 shading coefficient, 1.35 light-to-solar gain ratio (LSG).

## 2.3 HEAT-TREATED GLASS

### 2.3.1 Tempered Glass

Tempered glass shall be kind FT fully tempered transparent flat type, Class 1-clear and 2-tinted, Condition A uncoated surface, Quality q3 - glazing select, conforming to ASTM C 1048 and GANA Standards Manual.

## 2.4 SPANDREL GLASS

### 2.4.1 Ceramic-Opacified Spandrel Glass

Ceramic-opacified spandrel glass shall be kind HS heat-strengthened transparent flat type, Condition B, coated with a colored ceramic material on No. 2 surface, Quality q3 - glazing select, conforming to ASTM C 1048. Color shall match color in existing building: Bluegreen VE6-42#2.

## 2.5 MIRRORS

### 2.5.1 Glass Mirrors

Glass for mirrors shall be Type I transparent flat type, Class 1-clear, Glazing Quality q1 6 mm (1/4 inch) thick conforming to ASTM C 1036. Glass shall be coated on one surface with silver coating, copper protective coating, and mirror backing paint. Silver coating shall be highly adhesive pure silver coating of a thickness which shall provide reflectivity of 83 percent or more of incident light when viewed through 6 mm (1/4 inch) thick glass, and shall be free of pinholes or other defects. Copper protective coating shall be pure bright reflective copper, homogeneous without sludge, pinholes or other defects, and shall be of proper thickness to prevent "adhesion pull" by mirror backing paint. Mirror backing paint shall consist of two coats of special scratch and abrasion-resistant paint, and shall be baked in uniform thickness to provide a protection for silver and copper coatings which will permit normal cutting and edge fabrication.

### 2.5.2 Mirror Accessories

#### 2.5.2.1 Mastic

Mastic for setting mirrors shall be a polymer type mirror mastic resistant to water, shock, cracking, vibration and thermal expansion. Mastic shall be compatible with mirror backing paint, and shall be approved by mirror manufacturer.

#### 2.5.2.2 Mirror Clips

Concealed fasteners of type to suit wall construction material shall be provided with clips.

## 2.6 GLAZING ACCESSORIES

### 2.6.1 Preformed Tape

Preformed tape shall be elastomeric rubber extruded into a ribbon of a width and thickness suitable for specific application. Tape shall be of type which will remain resilient, have excellent adhesion, and be chemically compatible to glass and metal.

### 2.6.2 Sealant

Sealant shall be elastomeric conforming to ASTM C 920, Type S or M, Grade NS, Class 12.5, Use G, of type chemically compatible with setting blocks, preformed sealing tape and sealants used in manufacturing insulating glass. Color of sealant shall be black.

### 2.6.3 Glazing Gaskets

Glazing gaskets shall be extruded with continuous integral locking projection designed to engage into metal glass holding members to provide a watertight seal during dynamic loading, building movements and thermal movements. Glazing gaskets for a single glazed opening shall be continuous one-piece units with factory-fabricated injection-molded corners free of flashing and burrs. Glazing gaskets shall be in lengths or units recommended by manufacturer to ensure against pull-back at corners. Glazing gasket profiles shall be as indicated on drawings.

#### 2.6.3.1 Fixed Glazing Gaskets

Fixed glazing gaskets shall be closed-cell (sponge) smooth extruded compression gaskets of cured elastomeric virgin neoprene compounds conforming to ASTM C 509, Type 2, Option 1.

#### 2.6.3.2 Wedge Glazing Gaskets

Wedge glazing gaskets shall be high-quality extrusions of cured elastomeric virgin neoprene compounds, ozone resistant, conforming to ASTM C 864, Option 1, Shore A durometer between 65 and 75.

#### 2.6.3.3 Aluminum Framing Glazing Gaskets

Glazing gaskets for aluminum framing shall be permanent, elastic, non-shrinking, non-migrating, watertight and weathertight.

### 2.6.4 Setting and Edge Blocking

Neoprene setting blocks shall be dense extruded type conforming to ASTM D 395, Method B, Shore A durometer between 70 and 90. Edge blocking shall be Shore A durometer of 50 (+ or - 5). Silicone setting blocks shall be required when blocks are in contact with silicone sealant. Profiles, lengths and locations shall be as required and recommended in writing by glass manufacturer.

## PART 3 EXECUTION

### 3.1 PREPARATION

Openings and framing systems scheduled to receive glass shall be examined



for compliance with approved shop drawings, GANA Glazing Manual and glass manufacturer's recommendations including size, squareness, offsets at corners, presence and function of weep system, face and edge clearance requirements and effective sealing between joints of glass-framing members. Detrimental materials shall be removed from glazing rabbet and glass surfaces and wiped dry with solvent. Glazing surfaces shall be dry and free of frost.

### 3.2 INSTALLATION

Glass and glazing work shall be performed in accordance with approved shop drawings, GANA Glazing Manual, glass manufacturer's instructions and warranty requirements. Glass shall be installed with factory labels intact and removed only when instructed. Edges and corners shall not be ground, nipped or cut after leaving factory. Springing, forcing or twisting of units during installation will not be permitted.

### 3.3 CLEANING

Upon completion of project, outside surfaces of glass shall be washed clean and the inside surfaces of glass shall be washed and polished in accordance with glass manufacturer's recommendations.

### 3.4 PROTECTION

Glass work shall be protected immediately after installation. Glazed openings shall be identified with suitable warning tapes, cloth or paper flags, attached with non-staining adhesives. Protective material shall be placed far enough away from the coated glass to allow air to circulate to reduce heat buildup and moisture accumulation on the glass. Glass units which are broken, chipped, cracked, abraded, or otherwise damaged during construction activities shall be removed and replaced with new units.

-- End of Section --

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## SECTION 09250

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**11/01**

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## SECTION 09250

## GYPSUM BOARD

**11/01**

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

## AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A108.11 (1992) Interior Installation of  
Cementitious Backer Units

ANSI A118.9 (1992) Cementitious Backer Units

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 580 (1998) Stainless Steel Wire

ASTM A 853 (R1998) Steel Wire, Carbon, for General use

ASTM C 36/C 36M (1999) Gypsum Wallboard

ASTM C 79/C 79M (2001) Standard Specification for Treated  
Core and Nontreated Core Gypsum Sheathing  
Board

ASTM C 442/C 442M (1999; Rev. A) Gypsum Backing Board and  
Coreboard

ASTM C 475 (1994) Joint Compound and Joint Tape for  
Finishing Gypsum Board

ASTM C 754 (2000) Installation of Steel Framing  
members to receive screw attached gypsum  
panel products

ASTM C 840 (2001) Application and Finishing of Gypsum  
Board

ASTM C 954 (2000) Steel Drill Screws for the  
Application of Gypsum Board or Metal  
Plaster Bases to Steel Studs from 0.033  
in. (0.84 mm) to 0.112 in. (2.84 mm) in  
Thickness

ASTM C 1002 (2000) Steel Drill Screws for the  
Application of Gypsum Panel Products or  
Metal Plaster Bases

ASTM C 1047	(1999) Accessories for Gypsum Wallboard and Gypsum Veneer Base
ASTM C 1177/C 1177M	(1999) Standard Specification for Glass Mat Gypsum Substrate for use as Sheathing
ASTM C 1396/C 1396M	(2000) Standard Specification for Gypsum Board
ASTM D 1037	(1999) Standard Test Methods for Evaluating Properties of Wood-Base Fiber and Particle Panel Materials
ASTM D 2394	(1999) Standard Method for Simulated Service Testing of Wood and Wood-Base Finish Flooring
ASTM D 5420	(1998) Standard Test Method for Impact Resistance of Flat, Rigid Plastic Specimen by Means of a Striker Impacted by a Falling Weight (Gardner Impact)
ASTM E 84	(2001) Surface Burning Characteristics of Building Materials
ASTM E 695	(1997) Standard Method for Measure Relative Resistance of Wall, Floor and Roof Construction to Impact Loads

## GYPSUM ASSOCIATION (GA)

GA 214	(1996) Recommended Levels of Gypsum Board Finish
GA 216	(2000) Application and Finishing of Gypsum Board
GA 253	(1999) Application of Gypsum Sheathing

## UNDERWRITERS LABORATORIES (UL)

UL Fire Resist Dir	(2000) Fire Resistance Directory
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## 1.2 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures."

## SD-03 Product Data

Cementitious backer units

Glass Mat Covered or Reinforced Gypsum Sheathing

Glass Mat Covered or Reinforced Gypsum Sheathing Sealant

Impact Resistant Gypsum Board

Accessories

Submit for each type of gypsum board and for cementitious backer units.

#### SD-07 Certificates

Asbestos Free Materials; G, AO.

Certify that gypsum board types, gypsum backing board types, cementitious backer units, and joint treating materials do not contain asbestos.

### 1.3 DELIVERY, STORAGE, AND HANDLING

#### 1.3.1 Delivery

Deliver materials in the original packages, containers, or bundles with each bearing the brand name, applicable standard designation, and name of manufacturer, or supplier.

#### 1.3.2 Storage

Keep materials dry by storing inside a sheltered building. Where necessary to store gypsum board and cementitious backer units outside, store off the ground, properly supported on a level platform, and protected from direct exposure to rain, snow, sunlight, and other extreme weather conditions. Provide adequate ventilation to prevent condensation.

#### 1.3.3 Handling

Neatly stack gypsum board and cementitious backer units flat to prevent sagging or damage to the edges, ends, and surfaces.

### 1.4 ENVIRONMENTAL CONDITIONS

#### 1.4.1 Temperature

Maintain a uniform temperature of not less than 10 degrees C in the structure for at least 48 hours prior to, during, and following the application of gypsum board, cementitious backer units, and joint treatment materials, or the bonding of adhesives.

#### 1.4.2 Exposure to Weather

Protect gypsum board and cementitious backer unit products from direct exposure to rain, snow, sunlight, and other extreme weather conditions.

### 1.5 QUALIFICATIONS

Manufacturer shall specialize in manufacturing the types of material specified and shall have a minimum of 5 years of documented successful experience. Installer shall specialize in the type of gypsum board work required and shall have a minimum of 3 years of documented successful experience.

## PART 2 PRODUCTS

### 2.1 MATERIALS

Conform to specifications, standards and requirements specified herein. Provide gypsum board types, gypsum backing board types, cementitious backing units, and joint treating materials manufactured from asbestos free materials only.

#### 2.1.1 Gypsum Board

ASTM C 36/C 36M and ASTM C 1396/C 1396M.

##### 2.1.1.1 Regular

1200 mm wide, 15.9 mm thick, tapered edges.

##### 2.1.1.2 Type X (Special Fire-Resistant)

1200 mm wide, 15.9 mm thick, tapered edges.

#### 2.1.2 Glass Mat Covered or Reinforced Gypsum Sheathing

Exceeds physical properties of ASTM C 79/C 79M and ASTM C 1177/C 1177M. Provide 12.7 mm, gypsum sheathing. Gypsum board shall consist of a noncombustible water-resistant core, with a glass mat surfaces embedded to the gypsum core or reinforcing embedded throughout the gypsum core. Gypsum sheathing board shall be warranted for at least 6 months against delamination due to direct weather exposure. All joints, seams and penetrations shall be sealed with compatible sealant.

#### 2.1.3 Impact Resistant Gypsum Board

1200 mm wide, 15.9 mm thick, tapered edges.

Reinforced gypsum panel with imbedded fiber mesh or lexan backing testing in accordance with the following tests. Provide fasteners that meet manufacturer requirements and specifications stated within this section. Impact resistant gypsum board, when tested in accordance with ASTM E 84, shall have a flame spread rating of 25 or less and a smoke developed rating of 50 or less.

##### 2.1.3.1 Structural Failure Test

ASTM E 695 or ASTM D 2394 for structural failure (drop penetration). ASTM E 695 using a 27.2 kg sand filled leather bag, resisting no less than 407 N-m cumulative impact energy before failure or ASTM D 2394 using 139.7 mm hemispherical projectile resisting no less than 357 N-m before failure. Test specimen stud spacing shall be 406 mm or greater on center.

##### 2.1.3.2 Indentation Test

ASTM D 5420 or ASTM D 1037 for indentation resistance. ASTM D 5420 using a .907 kg weight with a 16 mm hemispherical impacting head dropped once 915 mm creating not more than 3.5 mm indentation or ASTM D 1037 using no less than 213 kg weight applied to the 11.13 mm diameter ball to create not more than a 0.5 mm indentation depth.

#### 2.1.4 Cementitious Backer Units

ANSI A118.9.

#### 2.1.5 Joint Treatment Materials



ASTM C 475.

#### 2.1.5.1 Embedding Compound

Specifically formulated and manufactured for use in embedding tape at gypsum board joints and compatible with tape, substrate and fasteners.

#### 2.1.5.2 Finishing or Topping Compound

Specifically formulated and manufactured for use as a finishing compound.

#### 2.1.5.3 All-Purpose Compound

Specifically formulated and manufactured to serve as both a taping and a finishing compound and compatible with tape, substrate and fasteners.

#### 2.1.5.4 Setting or Hardening Type Compound

Specifically formulated and manufactured for use with fiber glass mesh tape.

#### 2.1.5.5 Joint Tape

Cross-laminated, tapered edge, reinforced paper, or fiber glass mesh tape recommended by the manufacturer.

#### 2.1.6 Fasteners

##### 2.1.6.1 Screws

ASTM C 1002, Type "G", Type "S" or Type "W" steel drill screws for fastening gypsum board to gypsum board, wood framing members and steel framing members less than 0.84 mm thick. ASTM C 954 steel drill screws for fastening gypsum board to steel framing members 0.84 to 2.84 mm thick. Provide cementitious backer unit screws with a polymer coating.

#### 2.1.7 Hangers

Suspended ceiling runner channel hangers shall be soft, annealed steel wire not less than No. 8 SWG, conforming to ASTM A 853 or flat iron or steel straps, at least 2 x 22 mm size, coated with zinc, cadmium, or rust-inhibiting paint.

#### 2.1.8 Wire and Clip Type Fastenings

Tie wire, clips, rings, and other fastenings shall be corrosion-resisting steel conforming to ASTM A 580, composition 302, 304, or 316, Condition A, or nickel-copper alloy conforming to ASTM B 164, annealed condition except that walls, partitions, and other vertical surfaces not incorporated in ceiling construction may be erected with soft, annealed steel conforming to ASTM A 853.

#### 2.1.9 Tie Wire

Tie wire for constructing partitions and vertical furring, for securing metal lath to supports, and for lacing shall be not less than No. 18 SWG. Tie wire for other applications shall be not less than No. 16 SWG.

#### 2.1.10 Clips

Clips used in lieu of tie wire for securing the furring channels to the runner channels in ceiling construction shall be made from strip not less than 3 mm thick or shall be hairpin clip, formed of wire not less than 0.4 mm nominal diameter. Other clips and rings or fastenings of similar materials shall be equivalent in holding power to that provided by tie wire for the specific application.

#### 2.1.11 Shaftwall Liner Panel

ASTM C 442/C 442M. Shaftwall liner panel shall conform to UL Fire Resist Dir for the Design Number(s) indicated. Liner Panel shall be specifically manufactured for cavity shaftwall system, with water-resistant paper faces, bevel edges, single lengths to fit required conditions, 25.4 mm thick, by 610 mm wide.

#### 2.1.12 Accessories

ASTM C 1047. Fabricate from corrosion protected steel or plastic designed for intended use. Accessories manufactured with paper flanges are not acceptable. Flanges shall be free of dirt, grease, and other materials that may adversely affect bond of joint treatment. Provide prefinished or job decorated materials.

#### 2.1.13 Water

Clean, fresh, and potable.

### PART 3 EXECUTION

#### 3.1 EXAMINATION

##### 3.1.1 Framing and Furring

Verify that framing and furring are securely attached and of sizes and spacing to provide a suitable substrate to receive gypsum board and cementitious backer units. Verify that all blocking, headers and supports are in place to support plumbing fixtures and to receive soap dishes, grab bars, towel racks, and similar items. Do not proceed with work until framing and furring are acceptable for application of gypsum board and cementitious backer units.

#### 3.2 SUSPENDED CEILING FRAMING

Suspended ceiling system framing shall be installed in accordance with ASTM C 754.

##### 3.2.1 Hangers

Hangers shall be spaced not more than 1200 mm along runner channels and 900 mm in the other direction or 1050 mm in both directions unless otherwise indicated. Locations of hanger wires shall be coordinated with other work.

Hangers at ends of runner channels shall be located not more than 150 mm from wall. Hanger wire shall be looped around bottom chord of open-web steel joists, or secured to structural elements with suitable fasteners. Sags or twists which develop in the suspended system shall be adjusted. Damaged or faulty parts shall be replaced.

##### 3.2.2 Main Runners

Main runner channels shall be installed in accordance with ASTM C 754. Hanger wires shall be double strand, saddle-tied to runner channels and the ends of hanger wire shall be twisted three times around itself. Main runners shall be located to within 150 mm of the paralleling wall to support the ends of cross furring. Main runners shall not come in contact with abutting masonry or concrete walls. Where main runners are spliced, ends shall be overlapped 300 mm with flanges of channels interlocked, and shall be securely tied at each end of splice with wire looped twice around the channels.

### 3.2.3 Furring Channels

Furring channels shall be spaced in accordance with ASTM C 754. Furring channels shall be secured to the runner channels and to structural supports at each crossing with tie wire, hairpin clips, or equivalent fastenings. Furring channels shall be located within 50 mm of parallel walls and beams, and shall be cut 13 mm short of abutting walls.

### 3.2.4 Ceiling Openings

Support members shall be provided as required at ceiling openings for access panels, recessed light fixtures, and air supply or exhaust. Support members shall be not less than 38 mm main runner channels and vertically installed suspension wires or straps shall be located to provide at least the minimum support specified herein for furring and wallboard attachment. Intermediate structural members not a part of the structural system, shall be provided for attachment or suspension of support members.

### 3.2.5 Light Fixtures and Air Diffusers

Light fixtures and air diffusers shall be supported directly from supporting structural system, with seismic detailing per TI 809-4. Wires shall be provided at appropriate locations to carry the weight of recessed or surface mounted light fixtures and air diffusers.

### 3.2.6 Control Joints

Ceiling control joints for expansion and contraction shall be provided. A control joint or intermediate blocking shall be installed where ceiling framing members change direction.

#### 3.2.6.1 Interior Ceilings With Perimeter Relief

Control joints shall be installed so that linear dimensions between control joints shall not exceed 15 m in either direction nor more than 230 square meters.

#### 3.2.6.2 Interior Ceilings Without Perimeter Relief

Control joints shall be installed so that linear dimensions between control joints shall not exceed 9 m in either direction nor more than 84 square meters.

### 3.3 APPLICATION OF GYPSUM BOARD

Apply gypsum board to framing and furring members in accordance with ASTM C 840 or GA 216 and the requirements specified herein. Apply gypsum board with separate panels in moderate contact; do not force in place. Stagger end joints of adjoining panels. Neatly fit abutting end and edge joints.

Use gypsum board of maximum practical length. Cut out gypsum board as required to make neat close joints around openings. In vertical application of gypsum board, provide panels in lengths required to reach full height of vertical surfaces in one continuous piece. Surfaces of gypsum board and substrate members may be bonded together with an adhesive, except where prohibited by fire rating(s). Treat edges of cutouts for plumbing pipes, screwheads, and joints with water-resistant compound as recommended by the gypsum board manufacturer. Provide type of gypsum board for use in each system specified herein as indicated.

### 3.3.1 Application of Gypsum Board to Steel Framing and Furring

Apply in accordance with ASTM C 840, System VIII or GA 216.

### 3.3.2 Glass Mat Covered or Fiber Reinforced Gypsum Sheathing

Apply gypsum sheathing in accordance to gypsum association publication GA 253. Design details for joints and fasteners shall follow gypsum sheathing manufacturer's requirements and be properly installed to protect the substrate from moisture intrusion. Exposed surfaces of the gypsum sheathing shall not be left exposed beyond the manufacture's recommendation without a weather barrier cladding. Openings shall be properly flashed. All joints, seams and penetrations shall be sealed with compatible silicone sealant.

### 3.3.3 Control Joints

Control joints for expansion and contraction in the walls shall be constructed with double studs installed 13 mm apart in interior walls or wall furring where indicated on drawings. Control joint spacing shall not exceed 9 m. Control joints between studs in fire-rated construction shall be filled with firesafing insulation to match the fire-rating of construction. Control joints between studs in acoustically-rated construction shall be filled with insulation and sealed.

### 3.3.4 Application of Impact Resistant Gypsum Board

Apply in accordance with applicable system of ASTM C 840 as specified or GA 216. Follow manufacturers written instructions on how to cut, drill and attach board.

## 3.4 APPLICATION OF CEMENTITIOUS BACKER UNITS

### 3.4.1 Application

In wet areas (restrooms and shower rooms), apply cementitious backer units in accordance with ANSI A108.11. A 7.6 kg asphalt impregnated, continuous felt paper membrane shall be placed behind cementitious backer units, between backer units and studs. Membrane shall be placed with a minimum 150 mm overlap of sheets laid shingle style.

### 3.4.2 Joint Treatment

ANSI A108.11.

## 3.5 FINISHING OF GYPSUM BOARD

Tape and finish gypsum board in accordance with ASTM C 840, GA 214 and GA 216. Plenum areas above ceilings shall be finished to Level 1 in accordance with GA 214. Walls and ceilings to receive a heavy-grade wall

covering or have textured finish before painting shall be finished to Level 3 in accordance with GA 214. Walls and ceilings without critical lighting to receive flat paints, light textures, or wall coverings shall be finished to Level 4 in accordance with GA 214. Unless otherwise specified, all gypsum board walls, partitions and ceilings shall be finished to Level 5 in accordance with GA 214. Provide joint, fastener depression, and corner treatment. Do not use fiber glass mesh tape with conventional drying type joint compounds; use setting or hardening type compounds only. Provide treatment for water-resistant gypsum board as recommended by the gypsum board manufacturer.

#### 3.5.1 Uniform Surface

Wherever gypsum board is to receive eggshell, semigloss or gloss paint finish, or where severe, up or down lighting conditions occur, finish gypsum wall surface in accordance to GA 214 Level 5. In accordance with GA 214 Level 5, apply a thin skim coat of joint compound to the entire gypsum board surface, after the two-coat joint and fastener treatment is complete and dry.

#### 3.6 SEALING

Seal openings around pipes, fixtures, and other items projecting through gypsum board and cementitious backer units as specified in Section 07900 "Joint Sealing." Apply material with exposed surface flush with gypsum board or cementitious backer units.

##### 3.6.1 Sealing for Glass Mat or Reinforced Gypsum Board Sheathing

Apply silicone sealant in a 9.5 mm bead to all joints and trowel flat. Apply enough of the same sealant to all fasteners penetrating through the glass mat gypsum board surface to completely cover the penetration when troweled flat. Construction and materials shall not be placed behind sheathing until a visual inspection of sealed joints during daylight hours has been completed by Contracting Officer.

#### 3.7 FIRE-RESISTANT ASSEMBLIES

Wherever fire-rated construction is indicated, provide materials and application methods, including types and spacing of fasteners, wall framing in accordance with the specifications contained in UL Fire Resist Dir for the Design Number(s) indicated. Joints of fire-rated gypsum board enclosures shall be closed and sealed in accordance with UL test requirements or GA requirements. Penetrations through rated partitions and ceilings shall be sealed tight in accordance with tested systems. Fire ratings shall be as indicated.

#### 3.8 PATCHING

Patch surface defects in gypsum board to a smooth, uniform appearance, ready to receive finish as specified.

#### 3.9 SHAFT WALL FRAMING

The shaft wall system shall be installed in accordance with the system manufacturer's published instructions. Bucks, anchors, blocking and other items placed in or behind shaft wall framing shall be coordinated with electrical and mechanical work. Fireproofing materials which are damaged or removed during shaft wall construction shall be patched or replaced.

### 3.10 TESTING

Following completion of partition construction and door installation, demonstrate compliance of aconstically rated partitions with minimum STC ratings indicated by testing in accordance with ASTM E 336. Coordinate sound testing with testing required under Section 08385 SOUND RETARDANT SWINGING DOORS.

#### 3.10.1 Test Procedure

Place a calibrated noise source that generates sounds at accurate frequency and noise levels inside secure room. Produce sound at one-third octave band center frequencies and measure sound level outside of room in front of partition, and away from door.

#### 3.10.2 Test Reporting

Determine sound loss for each frequencies and report noise isolation class.

#### 3.10.3 Corrections

At any partitions that test deficiently, isolate and correct all observed noise leaks. If necessary, re-construct partitions to correct deficient noise isolation performance. Retest and report findings.

-- End of Section --

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## SECTION 09310

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## SECTION 09310

## CERAMIC TILE, QUARRY TILE, AND PAVER TILE

8/02

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A108.1A	(1992) Installation of Ceramic Tile in the Wet-Set Method, with Portland Cement Mortar
ANSI A108.1B	(1992) Installation of Ceramic Tile on a Cured Portland Cement Mortar Setting Bed with Dry-Set or Latex Portland Cement Mortar
ANSI A108.5	(1992) Installation of Ceramic Tile with Dry-Set Portland Cement Mortar or Latex-Portland Cement Mortar
ANSI A108.10	(1992) Installation of Grout in Tilework
ANSI A118.4	(1992) Latex-Portland Cement Mortar
ANSI A118.6	(1992) Ceramic Tile Grouts
ANSI A118.9	(1992) Test Methods and Specifications for Cementitious Backer Units
ANSI A137.1	(1988) Ceramic Tile

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 33	(1999a) Concrete Aggregates
ASTM C 144	(1999) Aggregate for Masonry Mortar
ASTM C 150	(1999a) Portland Cement
ASTM C 206	(1984; R 1997) Finishing Hydrated Lime
ASTM C 207	(1991; R 1997) Hydrated Lime for Masonry Purposes
ASTM C 241	(1997) Abrasion Resistance of Stone Subjected to Foot Traffic
ASTM C 373	(1988; R 1994) Water Absorption, Bulk Density, Apparent Porosity, and Apparent

## Specific Gravity of Fired Whiteware Products

ASTM C 482	(1981; R 1996) Bond Strength of Ceramic Tile to Portland Cement
ASTM C 501	(1984; R 1996) Relative Resistance to Wear of Unglazed Ceramic Tile by the Taber Abraser
ASTM C 648	(1998) Breaking Strength of Ceramic Tile
ASTM C 1026	(1987; R 1996) Measuring the Resistance of Ceramic Tile to Freeze-Thaw Cycling
ASTM C 1027	(1999) Determining Visible Abrasion Resistance of Glazed Ceramic Tile
ASTM C 1028	(1996) Determining the Static Coefficient of Friction of Ceramic Tile and Other Like Surfaces by the Horizontal Dynamometer Pull-Meter Method

## MARBLE INSTITUTE OF AMERICA (MIA)

MIA Design Manual	(1991) Design Manual IV Dimensional Stone
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## TILE COUNCIL OF AMERICA (TCA)

TCA Hdbk	(1997) Handbook for Ceramic Tile Installation
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## U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

36 CFR 1191	Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities
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## 1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

## SD-03 Product Data

Tile.  
Setting-Bed.  
Mortar, Grout, and Adhesive.

Manufacturer's catalog data and preprinted installation and cleaning instructions.

## SD-04 Samples

Tile; G, AE.

Marble Thresholds; G, AE.

Samples of sufficient size to show color range, pattern, type and joints.

#### SD-07 Certificates

Tile.

Mortar, Grout, and Adhesive.

Certificates indicating conformance with specified requirements. A master grade certificate shall be furnished for tile.

### 1.3 DELIVERY AND STORAGE

Materials shall be delivered to the project site in manufacturer's original unopened containers with seals unbroken and labels and hallmarks intact. Materials shall be kept dry, protected from weather, and stored under cover in accordance with manufacturer's instructions.

### 1.4 ENVIRONMENTAL REQUIREMENTS

Ceramic tile work shall not be performed unless the substrate and ambient temperature is at least 10 degrees C and rising. Temperature shall be maintained above 10 degrees C while the work is being performed and for at least 7 days after completion of the work. When temporary heaters are used they shall be vented to the outside to avoid carbon dioxide damage to new tilework.

### 1.5 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a 1-year period shall be provided.

### 1.6 EXTRA STOCK

Supply an extra two percent of each type tile used in clean and marked cartons.

## PART 2 PRODUCTS

### 2.1 TILE

Tile shall be standard grade conforming to ANSI A137.1. Containers shall be grade sealed. Seals shall be marked to correspond with the marks on the signed master grade certificate. Tile shall be impact resistant with a minimum breaking strength for wall tile of 41 kg and 113 kg for floor tile in accordance with ASTM C 648. Tile for cold climate projects shall be rated frost resistant by the manufacturer as determined by ASTM C 1026. Water absorption shall be 0.50 maximum percent in accordance with ASTM C 373.

Floor tile shall have a minimum coefficient of friction of 0.50 wet and dry in accordance with ASTM C 1028. Floor tile shall be Class III-Medium Heavy Traffic, durability classification as rated by the manufacturer when tested in accordance with ASTM C 1027 for abrasion resistance as related to foot traffic. Color shall be as shown on the Drawings.

#### 2.1.1 Mosaic Tile

Ceramic mosaic tile and trim shall be unglazed porcelain with cushion edges. Floor and wall tile size shall be 50 x 50 mm. Color shall be as shown on the Drawings.

#### 2.1.2 Textured Porcelain Tile (CT-6)

Porcelain tile and trim shall be unglazed with the color extending uniformly through the body of the tile. Tile size shall be nominal 203 by 203 mm. Tile shall meet or exceed the following criteria: Abrasive wear in accordance with ASTM C 501 and bonding strength in accordance with ASTM C 482. Tile shall comply with 36 CFR 1191 for coefficient of friction for interior floors. Color shall be as shown on the Drawings.

#### 2.1.3 Polished Porcelain Wall Tile (CT-5)

Polished-Porcelain wall tile and trim shall be cushion edged with matte glaze. Tile shall be 305 by 305 mm. Color shall be as shown on the Drawings.

#### 2.1.4 Accessories

Accessories shall be the built-in type of the same materials and finish as the wall tile. Accessories shall be provided as follows:

	Quantity	Location
a. Glazed Ceramic Surface Mounted soap holders	20	Showers

### 2.2 SETTING-BED

The setting-bed shall be composed of the following:

#### 2.2.1 Aggregate for Concrete Fill

Aggregate shall conform to ASTM C 33. Maximum size of coarse aggregate shall not be greater than one-half the thickness of concrete fill.

#### 2.2.2 Portland Cement

Cement shall conform to ASTM C 150, Type I, white for wall mortar and gray for other uses.

#### 2.2.3 Sand

Sand shall conform to ASTM C 144.

#### 2.2.4 Hydrated Lime

Hydrated lime shall conform to ASTM C 206, Type S or ASTM C 207, Type S.

### 2.3 WATER

Water shall be potable.

### 2.4 MORTAR, GROUT, AND ADHESIVE

Mortar, grout, and adhesive shall conform to the following:

## 2.4.1 Latex-Portland Cement Mortar

ANSI A118.4.

## 2.4.2 Ceramic Tile Grout

ANSI A118.6; latex-portland cement grout.

## 2.4.3 Cementitious Backer Board

Cementitious backer units, for use as tile substrate shall be in accordance with ANSI A118.9. Cementitious backer units shall be 12.7 mm thick.

## 2.5 MARBLE THRESHOLDS

Marble thresholds shall be of size required by drawings or conditions. Marble shall be Group A as classified by MIA Design Manual. Marble shall have a fine sand-rubbed finish and shall be white in color as approved by the Contracting Officer. Marble abrasion shall be not less than 12.0 when tested in accordance with ASTM C 241.

## PART 3 EXECUTION

## 3.1 PREPARATORY WORK AND WORKMANSHIP

Surface to receive tile shall be inspected and shall conform to the requirements of ANSI A108.1A or ANSI A108.1B for surface conditions for the type setting bed specified and for workmanship. Variations of surface to be tiled shall fall within maximum values shown below:

TYPE	WALLS	FLOORS
Latex portland cement mortar	3 mm in 2.4 meters	3.0 mm in 3 meters

## 3.2 GENERAL INSTALLATION REQUIREMENTS

Tile work shall not be started until roughing in for mechanical and electrical work has been completed and tested, and built-in items requiring membrane waterproofing have been installed and tested. Floor tile installation shall not be started in spaces requiring wall tile until after wall tile has been installed. Tile in colors and patterns indicated shall be applied in the area shown on the drawings. Tile shall be installed with the respective surfaces in true even planes to the elevations and grades shown. Special shapes shall be provided as required for sills, jambs, recesses, offsets, external corners, and other conditions to provide a complete and neatly finished installation. Tile bases and coves shall be solidly backed with mortar.

## 3.3 INSTALLATION OF WALL TILE

Wall tile shall be installed in accordance with the TCA Hdbk, method W-244.

## 3.3.1 Latex-Portland Cement Mortar

Latex-portland cement shall be used to install tile in accordance with ANSI A108.5. Latex portland cement shall be used when installing porcelain ceramic tile.

### 3.4 INSTALLATION OF FLOOR TILE

Floor tile shall be installed in accordance with TCA Hdbk, method F-113 for non shower areas located at elevated slabs, F-122 for showers at elevated slabs.

#### 3.4.1 Workable or Cured Mortar Bed

Floor tile shall be installed over a workable mortar bed or a cured mortar bed at the option of the Contractor. Workable mortar bed materials and installation shall conform to ANSI A108.1A. Cured mortar bed and materials shall conform to ANSI A108.1B. Joints between quarry tile shall be between 6.35 mm (1/4 inch) and 9.53 mm (3/8 inch) in width and shall be uniform in width.

#### 3.4.2 Latex-Portland Cement

Latex-portland cement mortar shall be used to install tile directly over properly cured, plane, clean concrete slabs in accordance with ANSI A108.5. Latex portland cement shall be used when installing porcelain ceramic tile.

#### 3.4.3 Ceramic Tile Grout

Ceramic Tile grout shall be prepared and installed in accordance with ANSI A108.10.

#### 3.4.4 Waterproofing

Two component liquid latex with continuous fiberglass reinforcement.

#### 3.4.5 Concrete Fill

Concrete fill shall be composed by volume of 1 part portland cement to 3 parts fine aggregate to 4 parts coarse aggregate, and mixed with water to as dry a consistency as practicable. The fill shall be spread, tamped, and screeded to a true plane, and pitched to drains or leveled as shown. Concrete fill shall be thoroughly damp cured before application of setting-bed material. Concrete fill shall be reinforced with one layer of reinforcement, with the uncut edges lapped the width of one mesh and the cut ends and edges lapped not less than 50 mm. Laps shall be tied together with 1.3 mm (18 gauge) wire every 250 mm along the finished edges and every 150 mm along the cut ends and edges. The reinforcement shall be supported and secured in the centers of concrete fills. The mesh shall be continuous; except where expansion joints occur, mesh shall be cut and discontinued across such joints. Reinforced concrete fill shall be provided under the setting-bed where the distance between the under-floor surface and the finished tile floor surface is 50 mm or greater, and shall be of such thickness that the mortar setting-bed over the concrete fill shall be not less nor more than the thickness required in the specified TCA Hdbk methods.

### 3.5 INSTALLATION OF MARBLE THRESHOLDS

Thresholds shall be installed where indicated in a manner similar to that of the ceramic tile floor. Thresholds shall be the full width of the opening. Head joints at ends shall not exceed 6 mm in width and shall be grouted full as specified for ceramic tile.

### 3.6 EXPANSION JOINTS

Joints shall be formed as indicated and sealed as specified in Section 07900 JOINT SEALING.

#### 3.6.1 Walls

Expansion joints shall be provided at control joints in backing material. Wherever backing material changes, an expansion joint shall be installed to separate the different materials.

#### 3.6.2 Floors

Expansion joints shall be provided over construction joints, control joints, and expansion joints in concrete slabs. Expansion joints shall be provided where tile abuts restraining surfaces such as perimeter walls, curbs and columns and at intervals of 7.2 to 10.8 m each way in large interior floor areas and 3.6 to 4.8 m each way in large exterior areas or areas exposed to direct sunlight or moisture. Expansion joints shall extend through setting-beds and fill.

#### 3.7 CLEANING AND PROTECTING

Upon completion, tile surfaces shall be thoroughly cleaned in accordance with manufacturer's approved cleaning instructions. Acid shall not be used for cleaning glazed tile. Floor tile with resinous grout or with factory mixed grout shall be cleaned in accordance with instructions of the grout manufacturer. After the grout has set, tile wall surfaces shall be given a protective coat of a noncorrosive soap or other approved method of protection. Tiled floor areas shall be covered with building paper before foot traffic is permitted over the finished tile floors. Board walkways shall be laid on tiled floors that are to be continuously used as passageways by workmen. Damaged or defective tiles shall be replaced.

-- End of Section --

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## SECTION 09445

RESINOUS TERRAZZO FLOORING  
01/96

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 56 (1998a) Flash Point by Tag Closed Tester

## NATIONAL TERRAZZO &amp; MOSAIC ASSOCIATION (NTMA)

NTMA Info Guide (1995) Terrazzo Information Guide

## 1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

## SD-02 Shop Drawings

Approved Detail Drawings; G, AE.  
Strips; G, AE.  
Control Joint Strips; G, AE.

Drawings indicating the type, size, and layout of divider strips and control joint strips.

## SD-03 Product Data

Resin.  
Mixing, Proportioning, and Installation.  
Cleaning and Sealing.

Resin manufacturer's descriptive data, mixing, proportioning, and installation instructions. Maintenance literature for terrazzo cleaning and sealing shall be included.

## SD-04 Samples

Resinous Terrazzo Flooring; G, AE.

Two 150 x 150 mm, (minimum) samples of each color of resinous terrazzo and two 150 mm lengths, of each type of strip.

## SD-07 Certificates

### Conductive Resinous Terrazzo Flooring.

Certificates indicating conformance with specified requirements. Certificates shall be accompanied by certified test reports showing that the conductive resinous terrazzo floor has been tested and meets the requirements specified.

#### 1.3 GENERAL

Resinous terrazzo flooring, in the colors indicated, shall be applied in the areas shown on the approved detail drawings. Flooring shall be an epoxy terrazzo system that conforms to the requirements specified in paragraphs 2.01A and B of NTMA Info Guide or a polyester terrazzo flooring system that conforms to the requirements specified in paragraphs 2.01A and B of NTMA Info Guide.

#### 1.4 QUALIFICATION OF APPLICATOR

Applicator shall be approved by the resin manufacturer and shall have a minimum of 3 years experience in the application of the materials to be used and shall have completed 8 successful installations within the past 2 years.

#### 1.5 DELIVERY AND STORAGE

Materials shall be delivered to the project site in manufacturer's original unopened containers. Materials shall be kept in a clean, dry, area with temperatures controlled between 10 to 33 degrees C.

#### 1.6 ENVIRONMENTAL REQUIREMENTS

Areas to receive terrazzo shall be maintained at a temperature above 10 degrees C for 2 days prior to installation and for 7 days following installation.

### PART 2 PRODUCTS

#### 2.1 PRIMER

Primer shall be a material recommended by the resin manufacturer which will penetrate the pores of the substrate and bond with the topping to form a permanent monolithic bond between the substrate and the topping.

#### 2.2 RESIN

Resin for the specified terrazzo flooring shall conform to the requirements shown in NTMA Info Guide.

#### 2.3 FILLERS

Fillers, if required, shall be inert mineral or cellulosic material as recommended by the manufacturer and best suited for the resin binder used. Fillers shall be furnished in the quantity necessary to impart the required color and physical characteristics.

#### 2.4 MARBLE CHIPS

Marble chips shall be of domestic origin of sizes and colors to match NTMA

Info Guide color plate indicated on the drawings. Chips shall be a range of sizes up to and including the NTMA Standard No. 0 and Standard No. 1 for 6 mm thick floors and Standard No. 0 through Standard No. 2 for 10 mm thick floors.

## 2.5 STRIPS

### 2.5.1 Divider Strips

Divider strips shall be depth as required, 3 mm and of brass.

### 2.5.2 Control Joint Strips

Control joint strips shall be depth as required, 3 mm and of brass. Neoprene filler shall be 10 mm thick in color as indicated on the drawings.

## 2.6 GROUT

Grout shall be as recommended by the manufacturer of the resin.

## 2.7 SEALER

Sealer shall have a pH factor between 7 and 10 and shall be a penetrating type specially prepared for use on terrazzo. The sealer shall not discolor or amber the terrazzo and shall produce a slip resistant surface. Flash point of sealer shall be a minimum of 27 degrees C when tested in accordance with ASTM D 56.

## PART 3 EXECUTION

### 3.1 PREPARATION OF CONCRETE SUBFLOOR

Installation of the floor topping shall not commence until the concrete substrate is at least 28 days old. The concrete surfaces shall be prepared in accordance with the instructions of the resin manufacturer.

### 3.2 MIXING, PROPORTIONING, AND INSTALLATION

Mixing, proportioning, and installing shall be in accordance with the approved instructions of the manufacturer. Strips shall be installed in locations indicated. The topping shall be applied to give a finish thickness of 6 - 10 mm. Bases shall be cove type cast-in-place with 1 inch radius cove and shall be 100 - 150 mm high.

### 3.3 CLEANING AND SEALING

The terrazzo shall be washed with a neutral cleaner and where required shall be cleaned with a fine abrasive to remove any stains or cement smears. The cleaned surfaces shall be rinsed. When dry, a terrazzo sealer shall be applied in accordance with the manufacturer's directions.

### 3.4 PROTECTION

The terrazzo work shall be covered and protected from damage until completion of the work of all other trades.

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## SECTION 09510

## ACOUSTICAL CEILINGS

07/02

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 635	(2000) Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-In Panel Ceilings
ASTM C 636	(1996) Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels
ASTM E 580	(2000) Application of Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels in Areas Requiring Moderate Seismic Restraint
ASTM E 795	(2000) Mounting Test Specimens During Sound Absorption Tests
ASTM E 1264	(1998) Acoustical Ceiling Products

## U.S. ARMY CORPS OF ENGINEERS (USACE)

TI 809-04	(1998) Seismic Design for Buildings
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## 1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

## SD-02 Shop Drawings

Approved Detail Drawings; G, AE.

Drawings showing suspension system, method of anchoring and fastening, details, and reflected ceiling plan.

## SD-03 Product Data

Acoustical Ceiling Systems.

Manufacturer's descriptive data, catalog cuts, and installation instructions. Submittals which do not provide adequate data for the product evaluation will be rejected.

#### SD-04 Samples

Acoustical Units; G, AE.

Two samples of each type of acoustical unit and each type of suspension grid tee section showing texture, finish, and color.

#### SD-07 Certificates

Acoustical Units.

Certificate attesting that the mineral based acoustical units furnished for the project contain recycled material and showing an estimated percent of such material.

### 1.3 GENERAL REQUIREMENTS

Acoustical treatment shall consist of sound controlling units mechanically mounted on a ceiling suspension system. The unit size, texture, finish, and color shall be as specified. The Contractor has the option to substitute inch-pound (I-P) Recessed Light Fixtures (RLF) for metric RLF. If the Contractor opts to furnish I-P RLF, other ceiling elements like acoustical ceiling tiles, air diffusers, air registers and grills, shall also be I-P products. The Contractor shall coordinate the whole ceiling system with other details, like the location of access panels and ceiling penetrations, etc., shown on the drawings. If I-P products are used, the Contractor shall be responsible for all associated labor and materials and for the final assembly and performance of the specified work and products. The location and extent of acoustical treatment shall be as shown on the approved detail drawings. Reclamation of mineral fiber acoustical ceiling panels to be removed from the job site shall be in accordance with paragraph RECLAMATION PROCEDURES.

### 1.4 DELIVERY AND STORAGE

Materials shall be delivered to the site in the manufacturer's original unopened containers with brand name and type clearly marked. Materials shall be carefully handled and stored in dry, watertight enclosures. Immediately before installation, acoustical units shall be stored for not less than 24 hours at the same temperature and relative humidity as the space where they will be installed in order to assure proper temperature and moisture acclimation.

### 1.5 ENVIRONMENTAL REQUIREMENTS

A uniform temperature of not less than 16 degrees C nor more than 29 degrees C and a relative humidity of not more than 70 percent shall be maintained for 24 hours before, during, and 24 hours after installation of acoustical units.

### 1.6 SCHEDULING

Interior finish work such as plastering, concrete and terrazzo work shall be complete and dry before installation. Mechanical, electrical, and other

work above the ceiling line shall be completed and heating, ventilating, and air conditioning systems shall be installed and operating in order to maintain temperature and humidity requirements.

#### 1.7 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a one year period shall be provided. Standard performance guarantee or warranty shall contain an agreement to repair or replace acoustical panels that fail within the warranty period. Failures include, but are not limited to, sagging and warping of panels; rusting and manufacturers defects of grid system.

#### 1.8 EXTRA MATERIALS

Spare tiles of each color shall be furnished at the rate of 5 tiles for each 1000 tiles installed. Tiles shall be from the same lot as those installed.

### PART 2 PRODUCTS

#### 2.1 ACOUSTICAL UNITS

Contractor shall comply with EPA requirements in accordance with Section 01670 RECYCLED / RECOVERED MATERIALS. Acoustical units shall conform to ASTM E 1264, Class A, and the following requirements:

##### 2.1.1 Units for Exposed-Grid System

Type: III (non-asbestos mineral fiber with painted finish) XII (fiberglass base with membrane-faced overlay).

Minimum NRC: 0.70 in open office areas, in conference rooms, executive offices, teleconferencing rooms, and other rooms as designated, in all other rooms and areas when tested on mounting Type E-400 of ASTM E 795.

Nominal size: 610 BY 610 mm.

Edge detail: Tegular.

Finish: Factory-applied standard finish.

Minimum LR coefficient: .065.

Flame Spread: Class A, 25 or less

#### 2.2 SUSPENSION SYSTEM

Suspension system shall be standard exposed-grid standard width flange, and shall conform to ASTM C 635 for intermediate-duty systems. Surfaces exposed to view shall be aluminum or steel with a factory-applied white baked-enamel finish. Wall molding shall have a flange of not less than 23 mm. Inside and outside corner caps shall be provided. Suspended ceiling framing system shall have the capability to support the finished ceiling, light fixtures, air diffusers, and accessories, as shown. The suspension system shall have a maximum deflection of 1/360 of span length. Seismic details shall conform to the guidance in TI 809-04 and ASTM E 580.

#### 2.3 HANGERS



Hangers and attachment shall support a minimum 1330 N ultimate vertical load without failure of supporting material or attachment.

## 2.4 FINISHES

Acoustical units and suspension system members shall have manufacturer's standard textures, patterns and finishes as specified. Ceiling suspension system components shall be treated to inhibit corrosion.

## 2.5 COLORS AND PATTERNS

Colors and patterns for acoustical units and suspension system components shall be as shown on the Drawings.

# PART 3 EXECUTION

## 3.1 INSTALLATION

Examine surfaces to receive directly attached acoustical units for unevenness, irregularities, and dampness that would affect quality and execution of the work. Areas where acoustical units will be cemented shall be free of oils, form residue, or other materials that reduce bonding capabilities of the adhesive. Interior finish work such as plastering, concrete, and terrazzo work shall be completed and dry before installation.

Mechanical, electrical, and other work above the ceiling line shall be completed and approved prior to the start of acoustical ceiling installation. Acoustical work shall be provided complete with necessary fastenings, clips, and other accessories required for a complete installation. Mechanical fastenings shall not be exposed in the finished work. Hangers shall be laid out for each individual room or space. Hangers shall be placed to support framing around beams, ducts, columns, grilles, and other penetrations through ceilings. Main runners and carrying channels shall be kept clear of abutting walls and partitions. At least two main runners shall be provided for each ceiling span. Wherever required to bypass an object with the hanger wires, a subsuspension system shall be installed, so that all hanger wires will be plumb.

### 3.1.1 Suspension System

Suspension system shall be installed in accordance with ASTM C 636 and as specified herein. There shall be no hanger wires or other loads suspended from underside of steel decking.

#### 3.1.1.1 Plumb Hangers

Hangers shall be plumb and shall not press against insulation covering ducts and pipes. Where lighting fixtures are supported from the suspended ceiling system, hangers shall be provided at a minimum of four hangers per fixture and located not more than 150 mm from each corner of each fixture.

#### 3.1.1.2 Splayed Hangers

Where hangers must be splayed (sloped or slanted) around obstructions, the resulting horizontal force shall be offset by bracing, countersplaying, or other acceptable means.

#### 3.1.2 Wall Molding

Wall molding shall be provided where ceilings abut vertical surfaces. Miter corners where wall moldings intersect or install corner caps. Wall molding shall be secured not more than 75 mm from ends of each length and not more than 400 mm on centers between end fastenings. Wall molding springs shall be provided at each acoustical unit in semi-exposed or concealed systems.

### 3.1.3 Acoustical Units

Acoustical units shall be installed in accordance with the approved installation instructions of the manufacturer. Edges of acoustical units shall be in close contact with metal supports, with each other, and in true alignment. Acoustical units shall be arranged so that units less than one-half width are minimized. Units in exposed-grid system shall be held in place with manufacturer's standard hold-down clips, if units weigh less than 5 kg per square m or if required for fire resistance rating.

### 3.2 CLEANING

Following installation, dirty or discolored surfaces of acoustical units shall be cleaned and left free from defects. Units that are damaged or improperly installed shall be removed and new units provided as directed.

### 3.4 RECLAMATION PROCEDURES

Ceiling tile, designated for recycling by the Contracting Officer, shall be neatly stacked on 1220 by 1220 mm pallets not higher than 1220 mm. Panels shall be completely dry. Pallets shall then be shrink wrapped and symmetrically stacked on top of each other without falling over. Disposal shall be in accordance with Section 01572 CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT.

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**08/02**

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## SECTION 09650

## RESILIENT FLOORING

08/02

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 4078	(1992; R 1996) Water Emulsion Floor Polish
ASTM E 648	(2000) Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source
ASTM E 662	(2001) Specific Optical Density of Smoke Generated by Solid Materials

## 1.2 FIRE RESISTANCE REQUIREMENTS

Flooring in corridors and exits shall have a minimum average critical radiant flux of 0.45 watts per square centimeter when tested in accordance with ASTM E 648. The smoke density rating shall be less than 450 when tested in accordance with ASTM E 662.

## 1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

## SD-02 Shop Drawings

Flooring; G, AE.

Drawings indicating location of seams, integral cove, including details of outside corner and cap, and edge strips.

## SD-03 Product Data

Flooring; G, AE.

Manufacturer's descriptive data and installation instructions including cleaning and maintenance instructions.

## SD-04 Samples

Flooring; G, AE.

Wall Base; G, AE.

Three samples of each indicated color and type of flooring and base. Sample size shall be minimum 60 x 100 mm.

#### SD-06 Test Reports

Moisture Test.

Copies of test reports showing that representative product samples of the flooring proposed for use have been tested by an independent testing laboratory within the past three years or when formulation change occurred and conforms to the requirements specified.

#### SD-08 Manufacturer's Instructions

Flooring; .

Copies of flooring manufacturer's recommended installation procedures.

#### SD-10 Operation and Maintenance Data

Data Package 1

Data Package in accordance with Section 01781 OPERATION AND MAINTENANCE DATA.

### 1.4 DELIVERY AND STORAGE

Materials shall be delivered to the building site in original unopened containers bearing the manufacturer's name, brands, stock names, production run, project identification, and handling instructions. Materials shall be stored in a clean dry area with temperature maintained above 21 degrees C for 2 days prior to installation, and shall be stacked according to manufacturer's recommendations. Materials shall be protected from the direct flow of heat from hot-air registers, radiators and other heating fixtures and appliances. Do not open containers until materials are to be used, except for inspection to verify compliance with requirements.

### 1.5 ENVIRONMENTAL REQUIREMENTS

a. Areas to receive resilient flooring shall be maintained at a temperature above 21 degrees C and below 38 degrees C for 2 days before application, during application and 2 days after application. A minimum temperature of 13 degrees C shall be maintained thereafter.

b. Provide adequate ventilation to remove moisture from area and to comply with regulations limiting concentrations of hazardous vapors.

### 1.6 SCHEDULING

Resilient flooring application shall be scheduled after the completion of other work which would damage the finished surface of the flooring.

### 1.7 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a one year period shall be provided.

## 1.8 EXTRA MATERIALS

Extra flooring material of each color and pattern shall be furnished at the rate of 0.5 m square meters for each 92 square meters of sheet flooring installed. Extra materials shall be from the same lot as those installed. Extra base material composed of 6 m of each color shall be furnished. All extra materials shall be packaged in original containers, properly marked.

## PART 2 PRODUCTS

### 2.1 UNDERLAYMENT

Underlayment shall be latex type, as recommended by flooring manufacturer. Wood and hardboard underlayments are specified in Section 06100N ROUGH CARPENTRY.

### 2.2 LINOLEUM FLOORING TYPE

Linoleum flooring shall be composed of oxidized linseed oil, resins, cork and/or wood materials. Flooring shall be not less than 2000 mm wide. Minimum overall thickness of 2 mm with a static load limit of 1034 kpa. PHYSICAL PROPERITIES

Slip Resistance: Meets or exceed Federal standards and A.D.A. recommendations of .6 for flat surfaces.

Fire Resistance: ASTM E-662/NFPA 258 (Smoke Density) 450 or less  
ASTM E-648/NFPA 253 (Critical Radiant Flux) Class 1  
FMVSS - 302 Meets or exceeds

Light Fastness: Light Fastness of at least 6, depending on color  
(Blue scale maximum is 8)

Castor Resistance: During 25,000 cycles of 3 wheels loaded with 66 lbs.  
No damage.

### 2.3 RESILIENT BASE

Base shall be manufacturers standard rubber straight style (installed with carpet) coved style (installed with linoleum flooring and conductive vinyl tile flooring) 100 mm high and a minimum 3 mm thick. Provide in 24 meters rolled goods. Preformed outside corners shall be furnished.

### 2.4 TRANSITION STRIP

A vinyl transition strip tapered to meet abutting material shall be provided.

### 2.5 ADHESIVE

Adhesive for flooring and wall base shall be as recommended by the flooring manufacturer.

### 2.6 POLISH

Polish shall conform to ASTM D 4078.

## 2.7 CAULKING AND SEALANTS

Caulking and sealants shall be in accordance with Section 07900 JOINT SEALING.

## 2.8 MANUFACTURER'S COLOR AND TEXTURE

Color and texture shall be as shown on the Drawings.

# PART 3 EXECUTION

## 3.1 EXAMINATION/VERIFICATION OF CONDITIONS

The Contractor shall examine and verify that site conditions are in agreement with the design package and shall report all conditions that will prevent a proper installation. The Contractor shall not take any corrective action without written permission from the Government.

## 3.2 SURFACE PREPARATION

Flooring shall be in a smooth, true, level plane, except where indicated as sloped. Before any work under this section is begun, all defects such as rough or scaling concrete, low spots, high spots, and uneven surfaces shall have been corrected, and all damaged portions of concrete slabs shall have been repaired as recommended by the flooring manufacturer. Concrete curing compounds, other than the type that does not adversely affect adhesion, shall be entirely removed from the slabs. Paint, varnish, oils, release agents, sealers, waxers, and adhesives shall be removed, as recommended by the flooring manufacturer.

## 3.3 MOISTURE TEST

The suitability of the concrete subfloor for receiving the resilient flooring with regard to moisture content shall be determined by a moisture test as recommended by the flooring manufacturer.

## 3.4 INSTALLATION OF LINOLEUM FLOORING

Linoleum flooring shall be installed with adhesive in accordance with the manufacturer's written installation instructions. Flooring shall be fitted to the room by hand cutting, straight scribing, or pattern scribing as necessary to suit job conditions. Flooring shall be cut to, and fitted around, all permanent fixtures, built-in furniture and cabinets, pipes, and outlets. Seams shall be cut by overlapping or underscribing as recommended by the manufacturer. Seams and edges of sheet vinyl flooring in room areas shall be welded as recommended by the manufacturer.

## 3.5 INSTALLATION OF RESILIENT BASE

Wall base shall be installed with adhesive in accordance with the manufacturer's written instructions. Base joints shall be tight and base shall be even with adjacent resilient flooring. Voids along the top edge of base at masonry walls shall be filled with caulk.

## 3.6 CLEANING

Immediately upon completion of installation of tile in a room or an area,

flooring and adjacent surfaces shall be cleaned to remove all surplus adhesive. After installation, flooring shall be washed with a cleaning solution, rinsed thoroughly with clear cold water, and, given two coats of polish in accordance with manufacturers written instructions. After each polish coat, floors shall be buffed to an even luster with an electric polishing machine.

### 3.7 PROTECTION

From the time of laying until acceptance, flooring shall be protected from damage as recommended by the flooring manufacturer. Flooring which becomes damaged, loose, broken, or curled shall be removed and replaced.

-- End of Section --



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## SECTION 09680

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**08/02**

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## SECTION 09680

CARPET  
08/02

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 3278	(1996e1) Test Methods for Flash Point of Liquids by Small Scale Closed-Cup Apparatus
ASTM E 648	(2000) Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source

## CARPET AND RUG INSTITUTE (CRI)

CRI 104	(1996) Commercial Carpet Installation Standard
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## U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

40 CFR 247	Comprehensive Procurement Guideline for Products Containing Recovered Materials
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## 1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

## SD-02 Shop Drawings

Installation; G, AE.  
Molding; G, AE.

Three copies of drawings indicating areas receiving carpet, carpet types, textures and patterns, direction of pile, location of seams, and locations of edge molding.

## SD-03 Product Data

Carpet.

Manufacturer's catalog data and printed documentation stating

physical characteristics, durability, resistance to fading, and flame resistance characteristics for each type of carpet material and installation accessory.

Surface Preparation.  
Installation.

Three copies of the manufacturer's printed installation instructions for the carpet, including preparation of substrate, seaming techniques, and recommended adhesives and tapes.

#### SD-04 Samples

Carpet; G, AE.  
Molding; G, AE.

a. Carpet: Two "Production Quality" samples 450 x 450 mm of each carpet proposed for use, showing quality, pattern, and color specified.

b. Vinyl Moldings: Two pieces of each type at least 300 mm long.

#### SD-06 Test Reports

Moisture and Alkalinity Tests.

Three copies of test reports of moisture and alkalinity content of concrete slab stating date of test, person conducting the test, and the area tested.

#### SD-07 Certificates

Carpet.

Certificates of compliance from a laboratory accredited by the National Laboratory Accreditation Program of the National Institute of Standards and Technology attesting that each type of carpet and carpet with cushion material conforms to the standards specified.

#### SD-10 Operation and Maintenance Data

Carpet.  
Cleaning and Protection.

Three copies of carpet manufacturer's maintenance instructions describing recommended type of cleaning equipment and material, spotting and cleaning methods, and cleaning cycles.

### 1.3 REGULATORY REQUIREMENTS

Carpet and adhesives shall bear the Carpet and Rug Institute (CRI) Indoor Air Quality (IAQ) label or demonstrate compliance with testing criteria and frequencies through independent laboratory test results. Carpet type bearing the label will indicate that the carpet has been tested and meets the criteria of the CRI IAQ Carpet Testing Program, and minimizes the impact on indoor air quality. Contractor shall procure carpet in accordance with 40 CFR 247.

#### 1.4 DELIVERY AND STORAGE

Materials shall be delivered to the site in the manufacturer's original wrappings and packages clearly labeled with the manufacturer's name, brand name, size, dye lot number, and related information. Materials shall be stored in a clean, dry, well ventilated area, protected from damage and soiling, and shall be maintained at a temperature above 16 degrees C for 2 days prior to installation.

#### 1.5 ENVIRONMENTAL REQUIREMENTS

Areas in which carpeting is to be installed shall be maintained at a temperature above 16 degrees C for 2 days before installation, during installation, and for 2 days after installation. A minimum temperature of 13 degrees C shall be maintained thereafter for the duration of the contract. Traffic or movement of furniture or equipment in carpeted area shall not be permitted for 24 hours after installation. Other work which would damage the carpet shall be completed prior to installation of carpet.

#### 1.6 WARRANTY

Manufacturer's standard performance guarantees or warranties including minimum ten (10) year wear warranty, two (2) year material and workmanship and ten (10) year tuft bind and delamination.

#### 1.7 EXTRA MATERIAL

Extra material from same dye lot consisting of full width continuous broadloom and uncut carpet tiles shall be provided for future maintenance. A minimum of 5 percent of total square meters of each carpet type, pattern, and color shall be provided.

### PART 2 PRODUCTS

#### 2.1 CARPET

Carpet shall be first quality; free of visual blemishes, streaks, poorly dyed areas, fuzzing of pile yarn, spots or stains, and other physical and manufacturing defects. Carpet materials and treatments shall be reasonably nonallergenic and free of other recognized health hazards. All grade carpets shall have a static control construction which gives adequate durability and performance.

#### 2.2 CARPET TYPE CP1

- a. Construction: Tip -sheared loop.
- b. Yarn Content: Nylon.
- c. Dye Method: Solution/Space Dye
- d. Machine Gauge: 1/10 in. (39.4 col./10 cm)
- e. Stitch Count: 13 SPI (51 2/10 cm)
- f. Pile Height Tufted: .219 in (5.56 mm) high
- g. Pile Thickness: .141 in (3.58 mm)
- h. Yarn Weight Tufted: 36 oz/yd2 (1220 g/m2)
- i. Density: 8425
- j. Primary Backing: Polypropylene
- k. Secondary Backing: Precision Plus
- l. Width: 12 feet (3.66 m)
- m. Static Control: Less than 3.5 K.V. step

- n. Flooring Radiant Panel: Class I (ASTM E 648)
- o. Soil Resistance: Scotchguard Protection
- p. Stain Resistance: 3m Stain Blocker
- q. Wear Warranty: 10 Year Limited Warranty

## 2.3 CARPET TYPE CP2

### Physical Characteristics

Carpet shall comply with the following:

- a. Construction: Textured Loop Pattern
- b. Yarn Content: Nylon.
- c. Dye Method: Solution/Space
- d. Machine Gauge: 1/10 in. (39.4 col./10 cm)
- e. Stitch Count: 13 SPI (51 2/10 cm)
- f. Pile Height Tufted: .187 in (4.76 mm) high  
.094 in (2.38 mm) low
- g. Pile Thickness: .141 in (3.58 mm)
- h. Yarn Weight Tufted: 30 oz/yd2 (1017 g/m2)
- i. Density: 7659
- j. Primary Backing: Polypropylene
- k. Secondary Backing: Precision Plus
- l. Width: 12 feet (3.66 m)
- m. Static Control: Less than 3.5 K.V.
- n. Flooring Radiant Panel: Class I (ASTM E 648)
- o. Soil Resistance: Scotchguard Protection  
For Commercial Carpet
- r. Stain Resistance: 3M Stain Blocker
- s. Wear Warranty: 10 Year Limited Warranty

## 2.4 CARPET TYPE CP3

Physical Characteristics Carpet shall comply with the following:

- a. Construction: Interloop Pattern
- b. Yarn Content: Nylon/continuous filament nylon.
- c. Dye Method: Solution/Space
- d. Machine Gauge: 1/12 in. (47.2 col./10 cm)
- e. Stitch Count: 10.3 SPI (40.7/10 cm)
- f. Pile Height Tufted: .281 in (7.14 mm) high  
.125 in (3.18 mm) low
- g. Pile Thickness: .188 in (4.76 mm)
- h. Yarn Weight Tufted: 32 oz/yd2 (1085 g/m2)
- i. Density: 5745
- j. Primary Backing: Polypropylene
- k. Secondary Backing: Precision Plus
- l. Width: 12 feet (3.66 m)
- m. Static Control: Less than 3.5 K.V. Step
- n. Flooring Radiant Panel: Class I (ASTM E 648)
- o. Soil Resistance: Scotchguard Protection  
For Commercial Carpet
- p. Stain Resistance: 3M Stain Blocker
- q. Wear Warranty: 10 Year Limited Warranty

## 2.5 CARPET TYPE CP4, CP5, CP6

Physical Characteristics: Carpet shall comply with the following:

- a. Construction: Cut and uncut textured loop
- b. Yarn Content: Dupont Antron Legacy Nylon
- c. Dye Method: Piece Dye
- d. Gauge: 1/8 in
- e. Stitch Count: 9.16
- f. Pile Height Turfted: .250 in (6.35mm)
- g. Yarn Weight Turfted: 38 oz/sy
- h. Density: 5184
- i. Primary Backing: Polypropylene
- j. Secondary Backing: Action BAC
- k. Width: 12 feet (3.66M)
- l. Static Control: Less than 3.5 K.V.
- m. Flooring Radiant Panel: Class 1
- n. Smoke Density: Less than 450
- o. Soil Resistance: Scotchguard Protection for Commercial Carpet
- p. Stain Resistance: 3M Stain Blocker
- q. Wear Warranty: 10 yr Limited Warranty

## 2.6 ACCESS CARPET TILE

Carpet surfacing shall be field installed using one full carpet square per panel. Carpet shall be nylon filament, loop pile, minimum 0.8 kg/square m, minimum density 4000, and without cushion. Carpet shall conform to ASTM E 648 with a minimum average critical radiant flux of 0.25 watts per square centimeter. Static control shall be less than 2.0 kV at 20 percent relative humidity at 21 degrees C.

## 2.7 CARPET TYPE AF1

- a. Construction : Multi-turf pattern loop.
- b. Yarn Content: Monsanto LXI type 6,6 nylon
- c. Dye Method: 60% Solution Dyed, 40% Yarn Dyed.
- d. Yarn Weight: 26 oz/sq. yd. (881g/m2)
- e. Total Weight: 162 oz./sq. yd. (5139 g/2)
- f. Size: Carpet tile 23.96" x 23.96" (881 g/m2 x 881 g/m2)
- g. Static Control: Helix 22 Denier
- h. Electrical Resistance: 2.5 x 10(4) Ohms Minimum  
1.0 x 10(8) Ohms Maximum
- i. Backing System: Dissipative Vinyl
- j. Flammability: Flooring Radiant Panel Class 1 per ASTM E648

## 2.8 Pad Type

- a. Density ASTM D-3574 16 lbs/cf
- b. Thickness ASTM D-3574 .227 in (5.7 mm)
- c. CFD ASTM D3574 25% 3.0 psi  
65% 20.9 psi
- d. Support Factor (Ratio CFD 65%/25%) 7.0 psi
- e. Compression Set (ASTM D 3574) 12%
- f. Resilience ASTM D-3574 34.4%
- g. Tensile Strength ASTM D-2646 159 lbs
- h. Elongation ASTM D-2646 20.5%
- i. Flammability DOC FF-1-70 Pill Test PASS
- j. Radiant Panel ASTM E-648 Class I
- k. NBS Smoke Density ASTM E-662 85
- l. Thermal Resistance ASTM C-518-76 0.772
- m. Width 6'
- n. Roll Length 100' Approx.

## 2.9 ADHESIVES AND CONCRETE PRIMER

Adhesives and concrete primers for installation of carpet shall be waterproof, nonflammable, meet local air-quality standards, and shall be as required by the carpet manufacturer. Seam adhesive shall be waterproof, nonflammable, and nonstaining as recommended by the carpet manufacturer. Release adhesive for modular tile carpet shall be as recommended by the carpet manufacturer. Adhesives flashpoint shall be minimum 60 degrees C in accordance with ASTM D 3278.

## 2.10 MOLDING

Vinyl molding shall be heavy-duty and designed for the type of carpet being installed. Floor flange shall be a minimum 50 mm wide. Color shall match the wall base.

## 2.11 TAPE

Tape for seams shall be as recommended by the carpet manufacturer for the type of seam used in installation.

## 2.12 COLOR, TEXTURE, AND PATTERN

Color, texture, and pattern shall be as indicated on the Drawings.

# PART 3 EXECUTION

## 3.1 SURFACE PREPARATION

Carpet shall not be installed on surfaces that are unsuitable and will prevent a proper installation. Holes, cracks, depressions, or rough areas shall be repaired using material recommended by the carpet or adhesive manufacturer. Floor shall be free of any foreign materials and swept broom clean. Before beginning work, subfloor shall be tested with glue and carpet to determine "open time" and bond.

## 3.2 MOISTURE AND ALKALINITY TESTS

Concrete slab shall be tested for moisture content and excessive alkalinity in accordance with CRI 104.

## 3.3 PREPARATION OF CONCRETE SUBFLOOR

Installation of the carpeting shall not commence until concrete substrate is at least 90 days old. The concrete surfaces shall be prepared in accordance with instructions of the carpet manufacturer. Type of concrete sealer, when required, shall be compatible with the carpet.

## 3.4 INSTALLATION

All work shall be performed by installers who are CFI certified (International Certified Floorcovering Installer Association), or manufacturer's approved installers. Installation shall be in accordance with the manufacturer's instructions and CRI 104. Edges of carpet meeting hard surface flooring shall be protected with molding; installation shall be in accordance with the molding manufacturer's instructions.

### 3.4.1 Broadloom Installation

Broadloom carpet shall be installed direct glue down and shall be smooth, uniform, and secure, with a minimum of seams. Seams shall be regular, unnoticeable, and treated with a seam adhesive. Side seams shall be run toward the light where practical and where such layout does not increase the number of seams. Breadths shall be installed parallel, with carpet pile in the same direction. Patterns shall be accurately matched. Cutouts, as at door jambs, columns and ducts shall be neatly cut and fitted securely. Seams at doorways shall be located parallel to and centered directly under doors. Seams shall not be made perpendicular to doors or at pivot points. Seams at changes in directions of corridors shall follow the wall line parallel to the carpet direction. Corridors with widths less than 1.8 m shall have the carpet laid lengthwise down the corridors.

#### 3.4.2 Modular Tile Installation for Raised Floor System

Modular tiles shall be field installed using a full carpet square per panel. Tiles shall be laid in the same direction with accessibility to the subfloor where required.

### 3.5 CLEANING AND PROTECTION

#### 3.5.1 Cleaning

After installation of the carpet, debris, scraps, and other foreign matter shall be removed. Soiled spots and adhesive shall be removed from the face of the carpet with appropriate spot remover. Protruding face yarn shall be cut off and removed. Carpet shall be vacuumed clean.

#### 3.5.2 Protection

The installed carpet shall be protected from soiling and damage with heavy, reinforced, nonstaining kraft paper, plywood, or hardboard sheets. Edges of kraft paper protection shall be lapped and secured to provide a continuous cover. Traffic shall be restricted for at least 45 hours. Protective covering shall be removed when directed by the Contracting Officer.

### 3.6 REMNANTS

Remnants remaining from the installation, consisting of scrap pieces more than 600 mm in dimension with more than 0.6 square meters total, shall be provided. Non-retained scraps shall be removed from site and recycled appropriately.

-- End of Section --



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SECTION 09720

WALLCOVERINGS

**07/02**

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- 3.4 CLEAN-UP

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## SECTION 09720

## WALLCOVERINGS

07/02

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM E 84 (2001) Surface Burning Characteristics of Building Materials

ASTM F 793 (1993; R 1998) Standard Classification of Wallcovering by Durability Characteristics

## 1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

## SD-03 Product Data

## Wallcoverings.

Manufacturer's descriptive data, documentation stating physical characteristics, flame resistance, mildew and germicidal characteristics.

## Installation.

Preprinted installation instructions for wallcovering and accessories.

## Maintenance.

## Clean-Up.

Preprinted cleaning and maintenance instructions for wallcovering and accessories.

## SD-04 Samples

## Wallcoverings; G, AE.

Three samples of each indicated type, pattern, and color of wallcovering. Samples of wall covering shall be minimum 125 x 175 mm and of sufficient size to show pattern repeat.

## SD-07 Certificates

## Wallcoverings.

Manufacturer's statement attesting that the product furnished meets or exceeds specification requirements. The statement must; be dated after the award of the contract, state Contractor's name and address, name the project and location, and list the requirements being certified.

## SD-08 Manufacturer's Instructions

## Wallcoverings.

Submit complete procedures for an expert installation, including preparation of the substrate. Submit Material Safety Data Sheets (MSDS) for all primers, sealers, and adhesives to the Contracting Officer.

## SD-10 Operation and Maintenance Data

## Wallcoverings, Data Package 1.

Submit operation and maintenance data in accordance with Section 01781 OPERATION AND MAINTENANCE DATA.

## 1.3 DELIVERY AND STORAGE

Deliver the material to the site in manufacturer's original wrappings and packages and clearly labeled with the manufacturer's name, brand name, size, and other related information. Store in a safe, dry, clean, and well-ventilated area at temperatures not less than 10 degrees C and within a relative humidity range of 30 to 60 percent. Store wall covering material in a flat position and protect from damage, soiling, and moisture. Do not open containers until needed for installation, unless verification inspection is required.

## 1.4 ENVIRONMENTAL REQUIREMENTS

Minimum temperature of area to receive wall covering, before, during, and after installation, and requirements for conditioning adhesive and wall covering shall comply with the wall covering manufacturer's printed instructions. However, in no case shall the area temperature be less than 10 degrees C, 72 hours prior to, during installation, and until the adhesive is dry. Observe ventilation and safety procedures specified in the MSDS.

## 1.5 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a one-year period shall be provided.

## 1.6 EXTRA MATERIALS

Provide one linear meter of full-width wall covering of each pattern and color for each 100 linear meters of wall covering installed. Extra stock shall be of the same manufacture, type, pattern, color, and lot number as the installed wall covering. Provide full rolls, packed for storage and

marked with content, pattern, and color. Leave extra stock at the site at a location as directed.

## PART 2 PRODUCTS

### 2.1 WALLCOVERINGS

Wallcoverings shall be material designed specifically for the specified use. The wallcovering shall contain a non-mercury based mildewcide. The wallcovering shall be type made without the use of cadmium based stabilizers. Wallcovering shall have a Class A flame spread rating of 0-25 and smoke development rating of 0-50 when tested in accordance with ASTM E 84.

#### 2.1.1 Vinyl Wallcovering Type (VWC-1)

Vinyl wallcovering shall be a vinyl coated woven or nonwoven fabric with germicidal additives and shall conform to ASTM F 793, Category V Type II, (.56 kg ) total weight per square meter and width of 1372 mm.

#### 2.1.2 Fabric Wall Covering - FWC-1

Fabric wallcovering shall be a woven fabric with a acrylic backing and shall be colorfast, stain and soil resistant. Fabric wallcovering shall meet or exceed the following:

- |                                         |                                     |
|-----------------------------------------|-------------------------------------|
| a. Content:                             | 100% Polyolefin                     |
| b. Finish:                              | Teflon                              |
| c. Width:                               | 1372 mm                             |
| d. Weight:                              | 257 g. per 0.9 lineal meter         |
| e. Abrasion resistance per ASTM D 3597  | 30,000 DR's                         |
| f. Bacterial resistance per ASTM D 3597 | Pass                                |
| g. Crocking, AATCC method 8             | Class 5                             |
| h. Lightfastness, AATCC 16A             | Class 5                             |
| i. Flammability, ASTM E 84              | Class A                             |
| j. Pattern and Color                    | Refer Section 09915, Color Schedule |

### 2.2 PRIMER AND ADHESIVE

Primer and adhesive shall be of a type recommended by the wallcovering manufacturer and shall contain a non-mercury based mildewcide. When substrate color variations show through vinyl wallcovering, a white pigmented primer as recommended by the wallcovering manufacturer shall be used to conceal the variations. Adhesive shall be strippable type. Adhesive to install cap shall be of a type recommended by the manufacturer of the wainscot cap.

### 2.3 COLOR, TEXTURE, AND PATTERN

Color, texture, and pattern shall be as shown on the Drawings.

## PART 3 EXECUTION

### 3.1 EXAMINATION

Contractor shall inspect all areas and conditions under which wallcoverings are to be installed. Contractor shall notify in writing of any conditions detrimental to the proper and timely completion of the installation. Work will proceed only when conditions have been corrected and accepted by the

installer.

### 3.2 SURFACE PREPARATION

Wallcovering shall not be applied to surfaces that are rough, that contain stains that will bleed through the wallcovering, or that are otherwise unsuitable for proper installation. Cracks and holes shall be filled and rough spots shall be sanded smooth. Surfaces to receive wallcovering shall be thoroughly dry. Plaster surfaces shall age at least 30 days prior to installation of vinyl wallcoverings. Interior surfaces of new and existing gypsum wallboard shall be primed with a wallcovering primer in accordance with the manufacturer's instructions. As required, white primer shall be used when substrate color variations are visible through thin or light color wallcovering. Interior surfaces of exterior masonry walls shall be sealed to prevent moisture penetration, then primed with a wallcovering primer in accordance with the manufacturer's instructions. Moisture content of plaster, concrete, and masonry shall be tested with an electric moisture meter and reading shall be not more than 5 percent. Masonry walls shall have flush joints. Concrete and masonry walls shall be coated with a thin coat of joint compound or cement plaster as a substrate preparation. To promote adequate adhesion of wall lining over masonry walls, the walls shall be primed as recommended by the wall lining manufacturer. Surface of walls shall be primed as required by manufacturer's instructions to permit ultimate removal of wallcovering from the wall surface. Primer shall be allowed to completely dry before adhesive application.

### 3.3 INSTALLATION

#### 3.3.1 Vinyl and Fabric Wallcovering

Wallcovering shall be installed in accordance with the manufacturer's installation instructions. Glue and adhesive spillage shall be immediately removed from wallcovering face and seams with a remover recommended by the manufacturer. After the installation is complete, the fabric wallcovering shall be vacuumed with a ceiling to floor motion.

### 3.4 CLEAN-UP

Upon completion of the work, wallcovering shall be left clean and free of dirt, soiling, stain, or residual film. Surplus materials, rubbish, and debris resulting from the wallcovering installation shall be removed and area shall be left clean.

-- End of Section --

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SECTION 09840

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**11/01**

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## SECTION 09840

ACOUSTICAL WALL TREATMENT  
11/01

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN ASSOCIATION OF TEXTILE CHEMISTS AND COLORISTS (AATCC)

AATCC 16 (1998) Test Method: Colorfastness to Light

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 423 (1999a) Sound Absorption and Sound  
Absorption Coefficients by the  
Reverberation Room Method

ASTM D 5034 (1995) Breaking Strength and Elongation of  
Textile Fabrics (Grab Test)

ASTM E 84 (2000a) Surface Burning Characteristics of  
Building Materials

## INTERNATIONAL CONFERENCE OF BUILDING OFFICIALS (ICBO)

ICBO UBC (1997) Uniform Building Code (3 Vol.)

## 1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

## SD-02 Shop Drawings

Approved Detail Drawings; G, AE.

Drawings showing plan locations, elevations and details.  
Drawings shall include details of method of anchorage, location of doors and other openings, base detail and shape and thickness of materials.

## SD-03 Product Data

Installation.

Manufacturer's installation instructions and recommended



cleaning instructions.

Acoustical Wall Panels.

Manufacturer's descriptive data and catalog cuts.

#### SD-04 Samples

Acoustical Wall Panels; G, AE.

Manufacturer's standard fabric swatches, minimum 450 mm wide by 600 mm long 2 samples of each color range specified.

#### SD-07 Certificates

Acoustical Wall Panels.

Certificates of compliance from an independent laboratory accredited by the National Laboratory Accreditation Program of the National Institute of Standards. A label or listing from the testing laboratory will be acceptable evidence of compliance.

### 1.3 DELIVERY AND STORAGE

Materials delivered and placed in storage shall be stored with protection from the weather, humidity and temperature variations, dirt, dust, or other contaminants.

### 1.4 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a one year period shall be provided.

## PART 2 PRODUCTS

### 2.1 FABRIC COVERED ACOUSTICAL WALL PANELS

Acoustical wall panels shall consist of prefinished factory assembled, seamless fabric covered, fiber glass or mineral fiber core system as described below. Wall panels shall be manufactured to the dimensions and configurations shown on the approved detail drawings. Perimeter edges shall be reinforced by either an aluminum frame or a formulated resin edge hardener. Acoustical wall panels installed in non-sprinklered areas must comply with the requirements of ICBO UBC, Standard 42-2.

- a. Panel Width: Panel width shall be as detailed.
- b. Panel Height: Heights shall be 762 mm.
- c. Thickness: Panel thickness shall be 25 mm.
- d. Fabric Covering: Seamless plain woven 2-ply 100 percent polyester, minimum 0.47 kg per linear meter. Tear strength shall be minimum 129 N. Tensile strength shall be 667 N minimum in accordance with ASTM D 5034. Fabric covering shall be stretched free of wrinkles and then bonded to the edges and back or bonded directly to the panel face, edges, and back of panel a minimum distance standard with the manufacturer. Light fastness (fadeometer) shall be approximately 40 hours in accordance with

## AATCC 16.

- e. Fire rating for the complete composite system: Class A, 200 or less smoke density and flame spread less than 25, when tested in accordance with ASTM E 84.
- f. Substrate: Fiber glass or mineral fiber.
- g. Noise Reduction Coefficient (NRC) Range: 0.80-0.90 ASTM C 423.
- h. Edge Detail: Square edge.
- i. Core Type: Standard acoustical rigid fiber glass, 6 to 7 pcf.
- j. Mounting: Acoustical panels shall be mounted by manufacturer's standard adhesive mounting.
- k. Color: Color shall be as indicated on the Drawings.

## PART 3 EXECUTION

## 3.1 SURFACE CONDITIONS

Walls shall be clean, smooth, oil free and prepared in accordance with panel manufacturer's instructions. Installation shall not begin until all wet work, such as, plastering, painting, and concrete are completely dry.

## 3.2 INSTALLATION

Panel installation shall be by personnel familiar with and normally engaged in installation of acoustical wall panels. Panels shall be applied in accordance with the manufacturer's installation instructions.

## 3.3 CLEANING

Following installation, dirty or stained panel surfaces shall be cleaned in accordance with manufacturer's instructions and left free from defects. Panels that are damaged, discolored, or improperly installed shall be removed and new panels provided as directed.

-- End of Section --

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## SECTION 09900

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## SECTION 09900

## PAINTS AND COATINGS

**02/02**

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

## AMERICAN CONFERENCE OF GOVERNMENTAL INDUSTRIAL HYGIENISTS (ACGIH)

ACGIH Limit Values	(1991-1992) Threshold Limit Values (TLVs) for Chemical Substances and Physical Agents and Biological Exposure Indices (BEIs)
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ACGIH TLV-DOC	Documentation of Threshold Limit Values and Biological Exposure Indices
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## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 235	Standard Specification for Mineral Spirits (Petroleum Spirits) (Hydrocarbon Dry Cleaning Solvent)
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ASTM D 523	(1999) Standard Test Method for Specular Gloss
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ASTM C 920	(1998) Elastomeric Joint Sealants
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ASTM D 2092	(1995) Preparation of Zinc-Coated (Galvanized) Steel Surfaces for Painting
-------------	----------------------------------------------------------------------------

ASTM D 4214	(1998) Evaluating the Degree of Chalking of Exterior Paint Films
-------------	------------------------------------------------------------------

ASTM D 4263	(1983; R 1999) Indicating Moisture in Concrete by the Plastic Sheet Method
-------------	----------------------------------------------------------------------------

ASTM D 4444	(1998) Standard Test Methods for Use and Calibration of Hand-Held Moisture Meters
-------------	-----------------------------------------------------------------------------------

ASTM F 1869	(1998) Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride
-------------	-----------------------------------------------------------------------------------------------------

## CODE OF FEDERAL REGULATIONS (CFR)

29 CFR 1910.1000	Air Contaminants
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## MASTER PAINTERS INSTITUTE (MPI)

MPI 2	(2001) Aluminum Heat Resistant Enamel (up
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	to 427 C and 800 F)
MPI 4	(2001) Interior/Exterior Latex Block Filler
MPI 23	(2001) Surface Tolerant Metal Primer
MPI 42	(2001) Latex Stucco and Masonry Textured Coating
MPI 50	(2001) Interior Latex Primer Sealer
MPI 54	(2001) Interior Latex, Semi-Gloss
MPI 57	(2001) Interior Oil Modified Clear Urethane, Satin
MPI 72	(2001) Polyurethane, Two Component, Pigmented, Gloss
MPI 77	(2001) Epoxy Cold Cured, Gloss
MPI 90	(2001) Interior Wood Stain, Semi-Transparent
MPI 95	(2001) Fast Drying Metal Primer
MPI 101	(2001) Cold Curing Epoxy Primer
MPI 119	(2001) Exterior Latex, High Gloss (acrylic)
MPI 141	(2001) High Performance Semigloss Latex, White and Tints - Gloss Level 5

## COMMERCIAL ITEM DESCRIPTION (CID)

CID A-A-2904	Thinner, Paint, Mineral Spirits, Regular and Odorless
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## STEEL STRUCTURES PAINTING COUNCIL (SSPC)

SSPC QP 1	(1989) Evaluating Qualifications of Painting Contractors (Field Application to Complex Structures)
SSPC PA 1	(2000) Shop, Field, and Maintenance Painting
SSPC VIS 1	(1989) Visual Standard for Abrasive Blast Cleaned Steel (Standard Reference Photographs)
SSPC VIS 3	(1993) Visual Standard for Power- and Hand-Tool Cleaned Steel (Standard Reference Photographs)
SSPC VIS 4	(2001) Guide and Reference Photographs for Steel Surfaces Prepared by Waterjetting
SSPC SP 1	(1982) Solvent Cleaning

SSPC SP 2	(1995) Hand Tool Cleaning
SSPC SP 3	(1995) Power Tool Cleaning
SSPC SP 6	(1994) Commercial Blast Cleaning
SSPC SP 7	(1994) Brush-Off Blast Cleaning
SSPC SP 10	(1994) Near-White Blast Cleaning
SSPC SP 12	(1995) Surface Preparation and Cleaning of Steel and Other Hard Materials by High-and Ultra high-Pressure Water Jetting Prior to Recoating

## 1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

The current MPI, "Approved Product List" which lists paint by brand, label, product name and product code as of the date of contract award, will be used to determine compliance with the submittal requirements of this specification. The Contractor may choose to use a subsequent MPI "Approved Product List", however, only one list may be used for the entire contract and each coating system is to be from a single manufacturer. All coats on a particular substrate must be from a single manufacturer. No variation from the MPI Approved Products List is acceptable.

Samples of specified materials may be taken and tested for compliance with specification requirements.

In keeping with the intent of Executive Order 13101, "Greening the Government through Waste Prevention, Recycling, and Federal Acquisition", products certified by SCS as meeting SCS SP01-01 shall be given preferential consideration over registered products. Products that are registered shall be given preferential consideration over products not carrying any EPP designation.

### SD-02 Shop Drawings

Piping identification.

Submit color stencil codes

### SD-03 Product Data

Coating.

Manufacturer's Technical Data Sheets.

### SD-04 Samples

Color; G, AE.

Submit manufacturer's samples of paint colors. Cross reference color samples to color scheme as indicated.

Textured Wall Coating System; G, AE.

Sample Textured Wall Coating System Mock-Up; G, AE.

#### SD-07 Certificates

Applicator's qualifications.

Qualification Testing laboratory for coatings.

#### SD-08 Manufacturer's Instructions

Application instructions.

Mixing.

Detailed mixing instructions, minimum and maximum application temperature and humidity, potlife, and curing and drying times between coats.

Manufacturer's Material Safety Data Sheets.

Submit manufacturer's Material Safety Data Sheets for coatings, solvents, and other potentially hazardous materials, as defined in FED-STD-313.

#### SD-10 Operation and Maintenance Data

Coatings.

Preprinted cleaning and maintenance instructions for all coating systems shall be provided.

### 1.3 APPLICATOR'S QUALIFICATIONS

#### 1.3.1 SSPC QP 1 Certification

All contractors and subcontractors that perform surface preparation or coating application shall be certified by the Society for Protective Coatings (formerly Steel Structures Painting Council) (SSPC) to the requirements of SSPC QP 1 prior to contract award, and shall remain certified while accomplishing any surface preparation or coating application. The painting contractors and painting subcontractors must remain so certified for the duration of the project. If a contractor's or subcontractor's certification expires, the firm will not be allowed to perform any work until the certification is reissued. Requests for extension of time for any delay to the completion of the project due to an inactive certification will not be considered and liquidated damages will apply. Notify the Contracting Officer of any change in contractor certification status.

### 1.4 QUALITY ASSURANCE

#### 1.4.1 Field Samples and Tests

The Contracting Officer may choose up to two coatings that have been



delivered to the site to be tested at no cost to the Government. Take samples of each chosen product as specified in the paragraph "Sampling Procedures." Test each chosen product as specified in the paragraph "Testing Procedure." Products which do not conform, shall be removed from the job site and replaced with new products that conform to the referenced specification. Testing of replacement products that failed initial testing shall be at no cost to the Government.

#### 1.4.1.1 Sampling Procedure

The Contracting Officer will select paint at random from the products that have been delivered to the job site for sample testing. The Contractor shall provide one liter samples of the selected paint materials. The samples shall be taken in the presence of the Contracting Officer, and labeled, identifying each sample. Provide labels in accordance with the paragraph "Packaging, Labeling, and Storage" of this specification.

#### 1.4.1.2 Testing Procedure

Provide Batch Quality Conformance Testing for specified products, as defined by and performed by MPI. As an alternative to Batch Quality Conformance Testing, the Contractor may provide Qualification Testing for specified products above to the appropriate MPI product specification, using the third-party laboratory approved under the paragraph "Qualification Testing" laboratory for coatings. The qualification testing lab report shall include the backup data and summary of the test results. The summary shall list all of the reference specification requirements and the result of each test. The summary shall clearly indicate whether the tested paint meets each test requirement. Note that Qualification Testing may take 4 to 6 weeks to perform, due to the extent of testing required.

Submit name, address, telephone number, FAX number, and e-mail address of the independent third party laboratory selected to perform testing of coating samples for compliance with specification requirements. Submit documentation that laboratory is regularly engaged in testing of paint samples for conformance with specifications, and that employees performing testing are qualified. If the Contractor chooses MPI to perform the Batch Quality Conformance testing, the above submittal information is not required, only a letter is required from the Contractor stating that MPI will perform the testing.

#### 1.4.2 Textured Wall Coating System

Three complete samples of each indicated type, pattern, and color of textured wall coating system applied to a panel of the same material as that on which the coating system will be applied in the work. Samples of wall coating systems shall be minimum 125 x 175 mm (5 x 7 inches) and of sufficient size to show pattern repeat and texture.

#### 1.4.3 Sample Textured Wall Coating System Mock-Up

After coating samples are approved, and prior to starting installation, a minimum 2430 mm x 2430 mm (8 foot x 8 foot) mock-up shall be provided for each substrate and for each color and type of textured wall coating, using the actual substrate materials. Once approved the mock-up samples shall be used as a standard of workmanship for installation within the facility. At least 48 hours prior to mock-up installation, the Contractor shall submit written notification to the Contracting Officer's Representative.

## 1.5 REGULATORY REQUIREMENTS

### 1.5.1 Environmental Protection

In addition to requirements specified elsewhere for environmental protection, provide coating materials that conform to the restrictions of the local Air Pollution Control District and regional jurisdiction. Notify Contracting Officer of any paint specified herein which fails to conform.

### 1.5.2 Lead Content

Do not use coatings having a lead content over 5 ppm weight of nonvolatile content.

### 1.5.3 Chromate Content

Do not use coatings containing zinc-chromate or strontium-chromate.

### 1.5.4 Asbestos Content

Materials shall not contain asbestos.

### 1.5.5 Mercury Content

Materials shall not contain mercury or mercury compounds.

### 1.5.6 Silica

Abrasive blast media shall not contain free crystalline silica.

### 1.5.7 Human Carcinogens

Materials shall not contain ACGIH Limit Values and ACGIH TLV-DOC confirmed human carcinogens (A1) or suspected human carcinogens (A2).

## 1.6 PACKAGING, LABELING, AND STORAGE

Paints shall be in sealed containers that legibly show the contract specification number, designation name, formula or specification number, batch number, color, quantity, date of manufacture, manufacturer's formulation number, manufacturer's directions including any warnings and special precautions, and name and address of manufacturer. Pigmented paints shall be furnished in containers not larger than 20 liters. Paints and thinners shall be stored in accordance with the manufacturer's written directions, and as a minimum, stored off the ground, under cover, with sufficient ventilation to prevent the buildup of flammable vapors, and at temperatures between 4 to 35 degrees C.

## 1.7 SAFETY AND HEALTH

Apply coating materials using safety methods and equipment in accordance with the following:

Work shall comply with applicable Federal, State, and local laws and regulations, and with the ACCIDENT PREVENTION PLAN, including the Activity Hazard Analysis as specified in Section 01525, "Safety Requirements" and in Appendix A of EM 385-1-1. The Activity Hazard Analysis shall include analyses of the potential impact of painting operations on painting

personnel and on others involved in and adjacent to the work zone.

#### 1.7.1 Safety Methods Used During Coating Application

Comply with the requirements of SSPC Guide 3.

#### 1.7.2 Toxic Materials

To protect personnel from overexposure to toxic materials, conform to the most stringent guidance of:

- a. The applicable manufacturer's Material Safety Data Sheets (MSDS) or local regulation.
- b. 29 CFR 1910.1000.
- c. ACGIH Limit Values, threshold limit values.

### 1.8 ENVIRONMENTAL CONDITIONS

#### 1.8.1 Coatings

Do not apply coating when air or substrate conditions are:

- a. Less than 3 degrees C above dew point;
- b. Below 10 degrees C or over 35 degrees C, unless specifically pre-approved by the Contracting Officer and the product manufacturer. Under no circumstances shall application conditions exceed manufacturer recommendations.

### 1.9 COLOR SELECTION

Colors of finish coats shall be as indicated or specified. Where not indicated or specified, colors shall be selected by the Contracting Officer. Manufacturers' names and color identification are used for the purpose of color identification only. Named products are acceptable for use only if they conform to specified requirements. Products of other manufacturers are acceptable if the colors approximate colors indicated and the product conforms to specified requirements.

Tint each coat progressively darker to enable confirmation of the number of coats.

Color, texture, and pattern of wall coating systems shall be as indicated on the Drawings.

#### 1.10 LOCATION AND SURFACE TYPE TO BE PAINTED

##### 1.10.1 Painting Included

Where a space or surface is indicated to be painted, include the following unless indicated otherwise.

- a. Surfaces behind portable objects and surface mounted articles readily detachable by removal of fasteners, such as screws and bolts.
- b. New factory finished surfaces that require identification or color

coding and factory finished surfaces that are damaged during performance of the work.

- c. Existing coated surfaces that are damaged during performance of the work.

#### 1.10.1.1 Exterior Painting

Includes new surfaces, existing coated surfaces, and existing uncoated surfaces, of the building and appurtenances as indicated. Also included are existing coated surfaces made bare by cleaning operations.

#### 1.10.1.2 Interior Painting

Includes new surfaces, existing uncoated surfaces, and existing coated surfaces of the building and appurtenances as indicated and existing coated surfaces made bare by cleaning operations. Where a space or surface is indicated to be painted, include the following items, unless indicated otherwise.

- a. Exposed columns, girders, beams, joists, and metal deck; and
- b. Other contiguous surfaces.

#### 1.10.2 Painting Excluded

Do not paint the following unless indicated otherwise.

- a. Surfaces concealed and made inaccessible by panelboards, fixed ductwork, machinery, and equipment fixed in place.
- b. Surfaces in concealed spaces. Concealed spaces are defined as enclosed spaces above suspended ceilings, furred spaces, attic spaces, crawl spaces, elevator shafts and chases.
- c. Steel to be embedded in concrete.
- d. Copper, stainless steel, aluminum, brass, and lead except existing coated surfaces.
- e. Hardware, fittings, and other factory finished items.

#### 1.10.3 Mechanical and Electrical Painting

Includes field coating of interior and exterior new and existing surfaces.

- a. Where a space or surface is indicated to be painted, include the following items unless indicated otherwise.
  - (1) Exposed piping, conduit, and ductwork;
  - (2) Supports, hangers, air grilles, and registers;
  - (3) Miscellaneous metalwork and insulation coverings.
- b. Do not paint the following, unless indicated otherwise:
  - (1) New zinc-coated, aluminum, and copper surfaces under insulation

- (2) New aluminum jacket on piping
- (3) New interior ferrous piping under insulation.

#### 1.10.3.1 Fire Extinguishing Sprinkler Systems

Clean, pretreat, prime, and paint new fire extinguishing sprinkler systems including valves, piping, conduit, hangers, supports, miscellaneous metalwork, and accessories. Apply coatings to clean, dry surfaces, using clean brushes. Clean the surfaces to remove dust, dirt, rust, and loose mill scale. Immediately after cleaning, provide the metal surfaces with one coat primer per schedules. Shield sprinkler heads with protective covering while painting is in progress. Upon completion of painting, remove protective covering from sprinkler heads. Remove sprinkler heads which have been painted and replace with new sprinkler heads. Provide primed surfaces with the following:

- a. Piping in Unfinished Areas: Provide primed surfaces with one coat of red alkyd gloss enamel applied to a minimum dry film thickness of 0.025 mm in attic spaces, spaces above suspended ceilings, crawl spaces, pipe chases, mechanical equipment room, and spaces where walls or ceiling are not painted or not constructed of a prefinished material. In lieu of red enamel finish coat, provide piping with 50 mm wide red enamel bands or self-adhering red plastic bands spaced at maximum of 6 meters intervals.
- b. Piping in Finished Areas: Provide primed surfaces with two coats of paint to match adjacent surfaces, except provide valves and operating accessories with one coat of red alkyd gloss enamel applied to a minimum dry film thickness of 0.025 mm. Provide piping with 50 mm wide red enamel bands or self-adhering red plastic bands spaced at maximum of 6 meters intervals throughout the piping systems.

#### 1.10.4 Definitions and Abbreviations

##### 1.10.4.1 Qualification Testing

Qualification testing is the performance of all test requirements listed in the product specification. This testing is accomplished by MPI to qualify each product for the MPI Approved Product List, and may also be accomplished by Contractor's third party testing lab if an alternative to Batch Quality Conformance Testing by MPI is desired.

##### 1.10.4.2 Batch Quality Conformance Testing

Batch quality conformance testing determines that the product provided is the same as the product qualified to the appropriate product specification. This testing shall only be accomplished by MPI testing lab.

##### 1.10.4.3 Coating

A film or thin layer applied to a base material called a substrate. A coating may be a metal, alloy, paint, or solid/liquid suspensions on various substrates (metals, plastics, wood, paper, leather, cloth, etc.). They may be applied by electrolysis, vapor deposition, vacuum, or mechanical means such as brushing, spraying, calendering, and roller coating. A coating may be applied for aesthetic or protective purposes or

both. The term "coating" as used herein includes emulsions, enamels, stains, varnishes, sealers, epoxies, and other coatings, whether used as primer, intermediate, or finish coat. The terms paint and coating are used interchangeably.

#### 1.10.4.4 DFT or dft

Dry film thickness, the film thickness of the fully cured, dry paint or coating.

#### 1.10.4.5 DSD

Degree of Surface Degradation, the MPI system of defining degree of surface degradation. Five (5) levels are generically defined under the Assessment sections in the MPI Maintenance Repainting Manual.

#### 1.10.4.6 EPP

Environmentally Preferred Products, a standard for determining environmental preferability in support of Executive Order 13101.

#### 1.10.4.7 EXT

MPI short term designation for an exterior coating system.

#### 1.10.4.8 INT

MPI short term designation for an interior coating system.

#### 1.10.4.9 micron / microns

The metric measurement for 0.001 mm or one/one-thousandth of a millimeter.

#### 1.10.4.10 mil / mils

The English measurement for 0.001 in or one/one-thousandth of an inch, equal to 25.4 microns or 0.0254 mm.

#### 1.10.4.11 mm

The metric measurement for millimeter, 0.001 meter or one/one-thousandth of a meter.

#### 1.10.4.12 MPI Gloss Levels

MPI system of defining gloss. Seven (7) gloss levels (G1 to G7) are generically defined under the Evaluation sections of the MPI Manuals. Traditionally, Flat refers to G1/G2, Eggshell refers to G3, Semigloss refers to G5, and Gloss refers to G6.

Gloss levels are defined by MPI as follows:

Gloss Level	Description	Units @ 60 degrees	Units @ 85 degrees
G1	Matte or Flat	0 to 5	10 max
G2	Velvet	0 to 10	10 to 35
G3	Eggshell	10 to 25	10 to 35
G4	Satin	20 to 35	35 min

G5	Semi-Gloss	35 to 70
G6	Gloss	70 to 85
G7	High Gloss	

Gloss is tested in accordance with ASTM D 523. Historically, the Government has used Flat (G1 / G2), Eggshell (G3), Semi-Gloss (G5), and Gloss (G6).

#### 1.10.4.13 MPI System Number

The MPI coating system number in each Division found in either the MPI Architectural Painting Specification Manual or the Maintenance Repainting Manual and defined as an exterior (EXT/REX) or interior system (INT/RIN). The Division number follows the CSI Master Format.

#### 1.10.4.14 Paint

See Coating definition.

#### 1.10.4.15 REX

MPI short term designation for an exterior coating system used in repainting projects or over existing coating systems.

#### 1.10.4.16 RIN

MPI short term designation for an interior coating system used in repainting projects or over existing coating systems.

### PART 2 PRODUCTS

#### 2.1 MATERIALS

Conform to the coating specifications and standards referenced in PART 3. Submit manufacturer's technical data sheets for specified coatings and solvents.

### PART 3 EXECUTION

#### 3.1 PROTECTION OF AREAS AND SPACES NOT TO BE PAINTED

Prior to surface preparation and coating applications, remove, mask, or otherwise protect, hardware, hardware accessories, machined surfaces, radiator covers, plates, lighting fixtures, public and private property, and other such items not to be coated that are in contact with surfaces to be coated. Following completion of painting, workmen skilled in the trades involved shall reinstall removed items. Restore surfaces contaminated by coating materials, to original condition and repair damaged items.

#### 3.2 RESEALING OF EXISTING EXTERIOR JOINTS

##### 3.2.1 Surface Condition

Surfaces shall be clean, dry to the touch, and free from frost and moisture; remove grease, oil, wax, lacquer, paint, defective backstop, or other foreign matter that would prevent or impair adhesion. Where adequate grooves have not been provided, clean out to a depth of 13 mm and grind to a minimum width of 6 mm without damage to adjoining work. Grinding shall

not be required on metal surfaces.

### 3.2.2 Backstops

In joints more than 13 mm deep, install glass fiber roving or neoprene, butyl, polyurethane, or polyethylene foams free of oil or other staining elements as recommended by sealant manufacturer. Backstop material shall be compatible with sealant. Do not use oakum and other types of absorptive materials as backstops.

### 3.2.3 Primer and Bond Breaker

Install the type recommended by the sealant manufacturer.

### 3.2.4 Ambient Temperature

Between 4 degrees C and 35 degrees C when applying sealant.

### 3.2.5 Exterior Sealant

For joints in vertical surfaces, provide ASTM C 920, Type S or M, Grade NS, Class 25, Use NT. For joints in horizontal surfaces, provide ASTM C 920, Type S or M, Grade P, Class 25, Use T. Color(s) shall be selected by the Contracting Officer. Apply the sealant in accordance with the manufacturer's printed instructions. Force sealant into joints with sufficient pressure to fill the joints solidly. Sealant shall be uniformly smooth and free of wrinkles.

### 3.2.6 Cleaning

Immediately remove fresh sealant from adjacent areas using a solvent recommended by the sealant manufacturer. Upon completion of sealant application, remove remaining smears and stains and leave the work in a clean condition. Allow sealant time to cure, in accordance with manufacturer's recommendations, prior to coating.

## 3.3 SURFACE PREPARATION

Remove dirt, splinters, loose particles, grease, oil, disintegrated coatings, and other foreign matter and substances deleterious to coating performance as specified for each substrate before application of paint or surface treatments. Oil and grease shall be removed prior to mechanical cleaning. Cleaning shall be programmed so that dust and other contaminants will not fall on wet, newly painted surfaces. Exposed ferrous metals such as nail heads on or in contact with surfaces to be painted with water-thinned paints, shall be spot-primed with a suitable corrosion-inhibitive primer capable of preventing flash rusting and compatible with the coating specified for the adjacent areas.

### 3.3.1 Additional Requirements for Preparation of Surfaces With Existing Coatings

Before application of coatings, perform the following on surfaces covered by soundly-adhered coatings, defined as those which cannot be removed with a putty knife:

- a. Wipe previously painted surfaces to receive solvent-based coatings, except stucco and similarly rough surfaces clean with a clean, dry cloth saturated with mineral spirits, ASTM D 235.



Allow surface to dry. Wiping shall immediately precede the application of the first coat of any coating, unless specified otherwise.

- b. Sand existing glossy surfaces to be painted to reduce gloss. Brush, and wipe clean with a damp cloth to remove dust.
- c. The requirements specified are minimum. Comply also with the application instructions of the paint manufacturer.
- d. Previously painted surfaces damaged during construction shall be thoroughly cleaned of all grease, dirt, dust or other foreign matter.
- e. Blistering, cracking, flaking and peeling or other deteriorated coatings shall be removed.
- f. Chalk shall be removed so that when tested in accordance with ASTM D 4214, the chalk resistance rating is no less than 8.
- g. Slick surfaces shall be roughened. Damaged areas such as, but not limited to, nail holes, cracks, chips, and spalls shall be repaired with suitable material to match adjacent undamaged areas.
- h. Edges of chipped paint shall be feather edged and sanded smooth.
- i. Rusty metal surfaces shall be cleaned as per SSPC requirements. Solvent, mechanical, or chemical cleaning methods shall be used to provide surfaces suitable for painting.
- j. New, proposed coatings shall be compatible with existing coatings.

### 3.3.2 Existing Coated Surfaces with Minor Defects

Sand, spackle, and treat minor defects to render them smooth. Minor defects are defined as scratches, nicks, cracks, gouges, spalls, alligatoring, chalking, and irregularities due to partial peeling of previous coatings. Remove chalking by sanding or blasting so that when tested in accordance with ASTM D 4214, the chalk rating is not less than 8.

### 3.3.3 Removal of Existing Coatings

Remove existing coatings from the following surfaces:

- a. Surfaces containing large areas of minor defects;
- b. Surfaces containing more than 20 percent peeling area; and
- c. Surfaces designated by the Contracting Officer, such as surfaces where rust shows through existing coatings.

### 3.3.4 Substrate Repair

- a. Repair substrate surface damaged during coating removal;
- b. Sand edges of adjacent soundly-adhered existing coatings so they are tapered as smooth as practical to areas involved with coating removal; and

- c. Clean and prime the substrate as specified.

### 3.4 PREPARATION OF METAL SURFACES

#### 3.4.1 Existing and New Ferrous Surfaces

- a. Ferrous Surfaces including Shop-coated Surfaces and Small Areas That Contain Rust, Mill Scale and Other Foreign Substances: Solvent clean or detergent wash in accordance with SSPC SP 1 to remove oil and grease. Where shop coat is missing or damaged, clean according to SSPC SP 2, SSPC SP 3, SSPC SP 6, or SSPC SP 10. Brush-off blast remaining surface in accordance with SSPC SP 7; Water jetting to SSPC SP 12 WJ-4 may be used to remove loose coating and other loose materials. Use inhibitor as recommended by coating manufacturer to prevent premature rusting. Shop-coated ferrous surfaces shall be protected from corrosion by treating and touching up corroded areas immediately upon detection.
- b. Surfaces With More Than 20 Percent Rust, Mill Scale, and Other Foreign Substances: Clean entire surface in accordance with SSPC SP 6/SSPC SP 12 WJ-3 SSPC SP 10/SSPC SP 12 WJ-2.

#### 3.4.2 Final Ferrous Surface Condition:

For tool cleaned surfaces, the requirements are stated in SSPC SP 2 and SSPC SP 3. As a visual reference, cleaned surfaces shall be similar to photographs in SSPC VIS 3.

For abrasive blast cleaned surfaces, the requirements are stated in SSPC SP 7, SSPC SP 6, and SSPC SP 10. As a visual reference, cleaned surfaces shall be similar to photographs in SSPC VIS 1.

For waterjet cleaned surfaces, the requirements are stated in SSPC SP 12. As a visual reference, cleaned surfaces shall be similar to photographs in SSPC VIS 4.

#### 3.4.3 Galvanized Surfaces

- a. New or Existing Galvanized Surfaces With Only Dirt and Zinc Oxidation Products: Clean with solvent, steam, or non-alkaline detergent solution in accordance with SSPC SP 1. If the galvanized metal has been passivated or stabilized, the coating shall be completely removed by brush-off abrasive blast. New galvanized steel to be coated shall not be "passivated" or "stabilized" If the absence of hexavalent stain inhibitors is not documented, test as described in ASTM D 2092, Appendix X2, and remove by one of the methods described therein.
- b. Galvanized with Slight Coating Deterioration or with Little or No Rusting: Water jetting to SSPC SP 12 WJ3 to remove loose coating from surfaces with less than 20 percent coating deterioration and no blistering, peeling, or cracking. Use inhibitor as recommended by the coating manufacturer to prevent rusting.
- c. Galvanized With Severe Deteriorated Coating or Severe Rusting: Water jet to SSPC SP 12 WJ3 degree of cleanliness.

#### 3.4.4 Non-Ferrous Metallic Surfaces

Aluminum and aluminum-alloy, lead, copper, and other nonferrous metal surfaces.

- a. Surface Cleaning: Solvent clean in accordance with SSPC SP 1 and wash with mild non-alkaline detergent to remove dirt and water soluble contaminants.

#### 3.4.5 Terne-Coated Metal Surfaces

Solvent clean surfaces with mineral spirits, ASTM D 235. Wipe dry with clean, dry cloths.

#### 3.4.6 Existing Surfaces with a Bituminous or Mastic-Type Coating

Remove chalk, mildew, and other loose material by washing with a solution of 0.20 liter trisodium phosphate, 0.1 liter household detergent, 1.6 liters 5 percent sodium hypochlorite solution and 4.8 liters of warm water.

### 3.5 PREPARATION OF CONCRETE AND CEMENTITIOUS SURFACE

#### 3.5.1 Concrete and Masonry

- a. Curing: Concrete, stucco and masonry surfaces shall be allowed to cure at least 30 days before painting, except concrete slab on grade, which shall be allowed to cure 90 days before painting.

- b. Surface Cleaning: Remove the following deleterious substances.

(1) Dirt, Chalking, Grease, and Oil: Wash new and existing uncoated surfaces with a solution composed of 0.2 liter trisodium phosphate, 0.1 liter household detergent, and 6.4 liters of warm water. Then rinse thoroughly with fresh water. Wash existing coated surfaces with a suitable detergent and rinse thoroughly. For large areas, water blasting may be used.

(2) Fungus and Mold: Wash new, existing coated, and existing uncoated surfaces with a solution composed of 0.2 liter trisodium phosphate, 0.1 liter household detergent, 1.6 liters 5 percent sodium hypochlorite solution and 4.8 liters of warm water. Rinse thoroughly with fresh water.

(3) Paint and Loose Particles: Remove by wire brushing.

(4) Efflorescence: Remove by scraping or wire brushing followed by washing with a 5 to 10 percent by weight aqueous solution of hydrochloric (muriatic) acid. Do not allow acid to remain on the surface for more than five minutes before rinsing with fresh water. Do not acid clean more than 0.4 square meter of surface, per workman, at one time.

(5) Removal of Existing Coatings: For surfaces to receive textured coating MPI 42, remove existing coatings including soundly adhered coatings if recommended by textured coating manufacturer.

- c. Cosmetic Repair of Minor Defects: Repair or fill mortar joints and minor defects, including but not limited to spalls, in accordance with manufacturer's recommendations and prior to coating application.

- d. Allowable Moisture Content: Latex coatings may be applied to damp surfaces, but not to surfaces with droplets of water. Do not apply epoxies to damp vertical surfaces as determined by ASTM D 4263 or horizontal surfaces that exceed 3 lbs of moisture per 1000 square feet in 24 hours as determined by ASTM F 1869. In all cases follow manufacturers recommendations. Allow surfaces to cure a minimum of 30 days before painting.

### 3.5.2 Gypsum Board, Plaster, and Stucco

- a. Surface Cleaning: Plaster and stucco shall be clean and free from loose matter; gypsum board shall be dry. Remove loose dirt and dust by brushing with a soft brush, rubbing with a dry cloth, or vacuum-cleaning prior to application of the first coat material. A damp cloth or sponge may be used if paint will be water-based.
- b. Repair of Minor Defects: Prior to painting, repair joints, cracks, holes, surface irregularities, and other minor defects with patching plaster or spackling compound and sand smooth.
- c. Allowable Moisture Content: Latex coatings may be applied to damp surfaces, but not surfaces with droplets of water. Do not apply epoxies to damp surfaces as determined by ASTM D 4263. New plaster to be coated shall have a maximum moisture content of 8 percent, when measured in accordance with ASTM D 4444, Method A, unless otherwise authorized. In addition to moisture content requirements, allow new plaster to age a minimum of 30 days before preparation for painting.

### 3.5.3 Existing Asbestos Cement Surfaces

Remove oily stains by solvent cleaning with mineral spirits, CID A-A-2904 ASTM D 235. Remove loose dirt, dust, and other deleterious substances by brushing with a soft brush or rubbing with a dry cloth prior to application of the first coat material. Do not wire brush or clean using other abrasive methods. Surfaces shall be dry and clean prior to application of the coating.

## 3.6 PREPARATION OF WOOD AND PLYWOOD SURFACES

### 3.6.1 New, Existing Uncoated, and Existing Coated Plywood and Wood Surfaces, Except Floors:

- a. Wood surfaces shall be cleaned of foreign matter.

Surface Cleaning: Surfaces shall be free from dust and other deleterious substances and in a condition approved by the Contracting Officer prior to receiving paint or other finish. Do not use water to clean uncoated wood. Scrape to remove loose coatings. Lightly sand to roughen the entire area of previously enamel-coated wood surfaces.

- b. Removal of Fungus and Mold: Wash existing coated surfaces with a solution composed of 0.2 liter trisodium phosphate, 0.1 liter household detergent, 1.6 liters 5 percent sodium hypochlorite solution and 4.8 liters of warm water. Rinse thoroughly with fresh water.

- c. Moisture content of the wood shall not exceed 12 percent as measured by a moisture meter in accordance with ASTM D 4444, Method A, unless otherwise authorized.
- d. Wood surfaces adjacent to surfaces to receive water-thinned paints shall be primed and/or touched up before applying water-thinned paints.
- e. Cracks and Nailheads: Set and putty stop nailheads and putty cracks after the prime coat has dried.
- f. Cosmetic Repair of Minor Defects:
  - (1) Knots and Resinous Wood and Fire, Smoke, Water, and Color Marker Stained Existing Coated Surface: Prior to application of coating, cover knots and stains with two or more coats of 1.3-kg-cut shellac varnish, plasticized with 0.14 liters of castor oil per liter. Scrape away existing coatings from knotty areas, and sand before treating. Prime before applying any putty over shellacked area.
  - (2) Open Joints and Other Openings: Fill with whiting putty, linseed oil putty. Sand smooth after putty has dried.
  - (3) Checking: Where checking of the wood is present, sand the surface, wipe and apply a coat of pigmented orange shellac. Allow to dry before paint is applied.
- g. Prime Coat For New Exterior Surfaces: Prime coat wood doors, windows, frames, and trim before wood becomes dirty, warped, or weathered.

### 3.6.2 Interior Wood Surfaces, Stain Finish

Interior wood surfaces to receive stain shall be sanded. Oak and other open-grain wood to receive stain shall be given a coat of wood filler not less than 8 hours before the application of stain; excess filler shall be removed and the surface sanded smooth.

## 3.7 APPLICATION

### 3.7.1 Coating Application

Painting practices shall comply with applicable federal, state and local laws enacted to insure compliance with Federal Clean Air Standards. Apply coating materials in accordance with SSPC PA 1. SSPC PA 1 methods are applicable to all substrates, except as modified herein.

At the time of application, paint shall show no signs of deterioration. Uniform suspension of pigments shall be maintained during application.

Unless otherwise specified or recommended by the paint manufacturer, paint may be applied by brush, roller, or spray. Rollers for applying paints and enamels shall be of a type designed for the coating to be applied and the surface to be coated.

Paints, except water-thinned types, shall be applied only to surfaces that are completely free of moisture as determined by sight or touch.

Thoroughly work coating materials into joints, crevices, and open spaces. Special attention shall be given to insure that all edges, corners, crevices, welds, and rivets receive a film thickness equal to that of adjacent painted surfaces.

Each coat of paint shall be applied so dry film shall be of uniform thickness and free from runs, drops, ridges, waves, pinholes or other voids, laps, brush marks, and variations in color, texture, and finish. Hiding shall be complete.

Touch up damaged coatings before applying subsequent coats. Interior areas shall be broom clean and dust free before and during the application of coating material.

Apply paint to new fire extinguishing sprinkler systems including valves, piping, conduit, hangers, supports, miscellaneous metal work, and accessories. Shield sprinkler heads with protective coverings while painting is in progress. Remove sprinkler heads which have been painted and replace with new sprinkler heads. For piping in unfinished spaces, provide primed surfaces with one coat of red alkyd gloss enamel to a minimum dry film thickness of 0.025 mm. Unfinished spaces include attic spaces, spaces above suspended ceilings, crawl spaces, pipe chases, mechanical equipment room, and space where walls or ceiling are not painted or not constructed of a prefinished material. For piping in finished areas, provide prime surfaces with two coats of paint to match adjacent surfaces, except provide valves and operating accessories with one coat of red alkyd gloss enamel. Upon completion of painting, remove protective covering from sprinkler heads.

- a. Drying Time: Allow time between coats, as recommended by the coating manufacturer, to permit thorough drying, but not to present topcoat adhesion problems. Provide each coat in specified condition to receive next coat.
- b. Primers, and Intermediate Coats: Do not allow primers or intermediate coats to dry more than 30 days, or longer than recommended by manufacturer, before applying subsequent coats. Follow manufacturer's recommendations for surface preparation if primers or intermediate coats are allowed to dry longer than recommended by manufacturers of subsequent coatings. Each coat shall cover surface of preceding coat or surface completely, and there shall be a visually perceptible difference in shades of successive coats.
- c. Finished Surfaces: Provide finished surfaces free from runs, drops, ridges, waves, laps, brush marks, and variations in colors.
- d. Thermosetting Paints: Topcoats over thermosetting paints (epoxies and urethanes) should be applied within the overcoating window recommended by the manufacturer.
- e. Floors: For nonslip surfacing on level floors, as the intermediate coat is applied, cover wet surface completely with almandite garnet, Grit No. 36, with maximum passing U.S. Standard Sieve No. 40 less than 0.5 percent. When the coating is dry, use a soft bristle broom to sweep up excess grit, which may be reused, and vacuum up remaining residue before application of the topcoat. For nonslip surfacing on ramps, provide MPI 77 with non-skid additive, applied by roller in accordance with manufacturer's

instructions.

### 3.7.2 Mixing and Thinning of Paints

Reduce paints to proper consistency by adding fresh paint, except when thinning is mandatory to suit surface, temperature, weather conditions, application methods, or for the type of paint being used. Obtain written permission from the Contracting Officer to use thinners. The written permission shall include quantities and types of thinners to use.

When thinning is allowed, paints shall be thinned immediately prior to application with not more than 0.125 L of suitable thinner per liter. The use of thinner shall not relieve the Contractor from obtaining complete hiding, full film thickness, or required gloss. Thinning shall not cause the paint to exceed limits on volatile organic compounds. Paints of different manufacturers shall not be mixed.

### 3.7.3 Two-Component Systems

Two-component systems shall be mixed in accordance with manufacturer's instructions. Any thinning of the first coat to ensure proper penetration and sealing shall be as recommended by the manufacturer for each type of substrate.

### 3.7.4 Coating Systems

- a. Systems by Substrates: Apply coatings that conform to the respective specifications listed in the following Tables:

#### Table

Division 3. Exterior Concrete Paint Table  
Division 4. Exterior Concrete Masonry Units Paint Table  
Division 5. Exterior Metal, Ferrous and Non-Ferrous Paint Table  
Division 6. Exterior Wood; Dressed Lumber, Paneling, Decking,  
Shingles Paint Table  
Division 9: Exterior Stucco Paint Table  
Division 10. Exterior Cloth Coverings and Bituminous Coated  
Surfaces Paint Table

Division 3. Interior Concrete Paint Table  
Division 4. Interior Concrete Masonry Units Paint Table  
Division 5. Interior Metal, Ferrous and Non-Ferrous Paint Table  
Division 6. Interior Wood Paint Table  
Division 9: Interior Plaster, Gypsum Board, Textured Surfaces  
Paint Table

- b. Minimum Dry Film Thickness (DFT): Apply paints, primers, varnishes, enamels, undercoats, and other coatings to a minimum dry film thickness of 0.038 mm each coat unless specified otherwise in the Tables. Coating thickness where specified, refers to the minimum dry film thickness.
- c. Coatings for Surfaces Not Specified Otherwise: Coat surfaces which have not been specified, the same as surfaces having similar conditions of exposure.
- d. Existing Surfaces Damaged During Performance of the Work, Including New Patches In Existing Surfaces: Coat surfaces with

the following:

- (1) One coat of primer.
  - (2) One coat of undercoat or intermediate coat.
  - (3) One topcoat to match adjacent surfaces.
- e. Existing Coated Surfaces To Be Painted: Apply coatings conforming to the respective specifications listed in the Tables herein, except that pretreatments, sealers and fillers need not be provided on surfaces where existing coatings are soundly adhered and in good condition. Do not omit undercoats or primers.

### 3.8 COATING SYSTEMS FOR METAL

Apply coatings of Tables in Division 5 for Exterior and Interior.

- a. Apply specified ferrous metal primer on the same day that surface is cleaned, to surfaces that meet all specified surface preparation requirements at time of application.
- b. Inaccessible Surfaces: Prior to erection, use one coat of specified primer on metal surfaces that will be inaccessible after erection.
- c. Shop-primed Surfaces: Touch up exposed substrates and damaged coatings to protect from rusting prior to applying field primer.
- d. Surface Previously Coated with Epoxy or Urethane: Apply MPI 101, 0.038 mm DFT immediately prior to application of epoxy or urethane coatings.
- e. Pipes and Tubing: The semitransparent film applied to some pipes and tubing at the mill is not to be considered a shop coat, but shall be overcoated with the specified ferrous-metal primer prior to application of finish coats.
- f. Exposed Nails, Screws, Fasteners, and Miscellaneous Ferrous Surfaces. On surfaces to be coated with water thinned coatings, spot prime exposed nails and other ferrous metal with latex primer MPI 107.

### 3.9 COATING SYSTEMS FOR CONCRETE AND CEMENTITIOUS SUBSTRATES

Apply coatings of Tables in Division 3, 4 and 9 for Exterior and Interior.

### 3.10 COATING SYSTEMS FOR WOOD AND PLYWOOD

- a. Apply coatings of Tables in Division 6 for Exterior and Interior.
- b. Prior to erection, apply two coats of specified primer to treat and prime wood and plywood surfaces which will be inaccessible after erection.
- c. Apply stains in accordance with manufacturer's printed instructions.

### 3.11 INSPECTION AND ACCEPTANCE



In addition to meeting previously specified requirements, demonstrate mobility of moving components, including swinging and sliding doors, cabinets, and windows with operable sash, for inspection by the Contracting Officer. Perform this demonstration after appropriate curing and drying times of coatings have elapsed and prior to invoicing for final payment.

### 3.12 PAINT TABLES

All DFT's are minimum values.

#### 3.12.1 EXTERIOR PAINT TABLES

##### DIVISION 5: EXTERIOR METAL, FERROUS AND NON-FERROUS PAINT TABLE

##### STEEL / FERROUS SURFACES

A. New Steel that has been hand or power tool cleaned to SSPC SP 2 or SSPC SP 3

1. Aliphatic Polyurethane (high gloss) over high-build polyamide epoxy coating

Primer:	Intermediate:	Topcoat:
MPI 23	MPI 101	MPI 72
System DFT:	150 microns	

##### EXTERIOR GALVANIZED SURFACES

F. New Galvanized surfaces:

1. Aliphatic Polyurethane (high gloss) over universal polyamide epoxy primer

MPI EXT 5.3A-G5 (Semigloss)		
Primer:	Topcoat:	
MPI 101	MPI 72	
System DFT:	150 microns	

##### EXTERIOR SURFACES, OTHER METALS (NON-FERROUS)

I. Aluminum, aluminum alloy and other miscellaneous non-ferrous metal items not otherwise specified except hot metal surfaces, roof surfaces, and new prefinished equipment including galvanized steel doors and frames. Match surrounding finish:

1. Exterior waterborne acrylic enamel (gloss) over waterborne acrylic primer (flat).

Primer:	Topcoat:
MPI 95	MPI 119
System DFT:	93 microns

J. Surfaces adjacent to finish surfaces; Mechanical, Electrical, Fire extinguishing sprinkler systems including valves, conduit, hangers, supports, exposed copper piping, and miscellaneous metal items not otherwise specified except floors, hot metal surfaces, and new prefinished equipment. Match surrounding finish:

K. Hot metal surfaces including smokestacks subject to temperatures up to

EXTERIOR SURFACES, OTHER METALS (NON-FERROUS)  
177 degrees C (350 degrees F):

MPI 2, Heat Resistant Silicone Alkyd (Aluminum Color) over Universal Phenolic Alkyd Primer

### 3.12.2 INTERIOR PAINT TABLES

#### DIVISION 4: INTERIOR CONCRETE MASONRY UNITS PAINT TABLE

##### A. New and uncoated Existing Concrete masonry:

1. Waterborne Acrylic Enamel (Semi-Gloss) over Heavy Duty Acrylic Block Filler

Filler	Primer:	Intermediate:	Topcoat:
MPI 4	N/A	MPI 141	MPI 141
System DFT:	275 microns		

Fill all holes in masonry surface

#### DIVISION 5: INTERIOR METAL, FERROUS AND NON-FERROUS PAINT TABLE

##### INTERIOR STEEL / NON-FERROUS SURFACES

A. Metal, including galvanized doors and frames, Mechanical, Electrical, Fire extinguishing sprinkler systems including valves, conduit, hangers, supports, Surfaces adjacent to painted surfaces (Match surrounding finish), exposed copper piping, and miscellaneous metal items not otherwise specified except floors, hot metal surfaces, and new prefinished equipment:

1. Waterborne Acrylic Gloss Enamel over Waterborne Acrylic Primer

Primer:	Topcoat:
MPI 95	MPI 119
System DFT:	93 microns

B. Steel Surfaces, Exposed to View in Finished Areas, including Steel Doors and Frames.

1. Waterborne Acrylic Enamel (Gloss) over Acrylic Primer

Primer:	Topcoat: 119
MPI 95	
System DFT:	93 microns

#### DIVISION 6: INTERIOR WOOD PAINT TABLE

A. New and Existing, previously finished or stained Wood and Plywood, except floors; natural finish or stained:

1. Natural finish, oil-modified polyurethane

New; MPI INT 6.4J-G4 / Existing; MPI RIN 6.4L-G4		
Primer:	Intermediate:	Topcoat:
MPI 57	MPI 57	MPI 57

## DIVISION 6: INTERIOR WOOD PAINT TABLE

System DFT: 100 microns

## 2. Stained, oil-modified polyurethane

New; MPI INT 6.4E-G4 / Existing; MPI RIN 6.4G-G4

Stain:	Primer:	Intermediate:	Topcoat:
MPI 90	MPI 57	MPI 57	MPI 57

System DFT: 100 microns

## B. New and Existing, previously finished or stained Wood Doors; Natural Finish or Stained:

## 1. Natural finish, oil-modified polyurethane

New; MPI INT 6.3K-G4 / Existing; MPI RIN 6.3K-G4

Primer:	Intermediate:	Topcoat:
MPI 57	MPI 57	MPI 57

System DFT: 100 microns

Note: Sand between all coats per manufacturers recommendations.

## 2. Stained, oil-modified polyurethane

New; MPI INT 6.3E-G4 / Existing; MPI RIN 6.3E-G4

Stain:	Primer:	Intermediate:	Topcoat:
MPI 90	MPI 57	MPI 57	MPI 57

System DFT: 100 microns

Note: Sand between all coats per manufacturers recommendations.

## DIVISION 9: INTERIOR PLASTER, GYPSUM BOARD, TEXTURED SURFACES PAINT TABLE

## A. New and Existing, previously painted Wallboard not otherwise specified:

## 1. Latex

New; MPI INT 9.2A-G5 (Semigloss) / Existing; RIN 9.2A-G5 (Semigloss)

Primer:	Intermediate:	Topcoat:
MPI 50	MPI 54	MPI 54

System DFT: 100 microns

## B. New and Existing, previously painted Wallboard in toilets, food-preparation, food-serving, restrooms, shower areas, areas requiring a high degree of sanitation, and other high humidity areas not otherwise specified.:

## 3. Epoxy

New; MPI INT 9.2E-G6 (Gloss) / Existing; MPI RIN 9.2D-G6 (Gloss)

Primer:	Intermediate:	Topcoat:
MPI 50	MPI 77	MPI 77

System DFT: 100 microns

-- End of Section --

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## SECTION 10100

## VISUAL COMMUNICATIONS SPECIALTIES

**07/02**

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## SECTION 10100

## VISUAL COMMUNICATIONS SPECIALTIES

07/02

## PART 1 GENERAL

## 1.1 GENERAL REQUIREMENTS

The term visual display board when used herein project screens

## 1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

## SD-03 Product Data

Visual Display Boards.

Manufacturer's descriptive data and catalog cuts.  
Manufacturer's installation instructions, and cleaning and maintenance instructions.

## SD-06 Instructions

Projection Screens;

Preprinted installation instructions showing location of screen center line, wiring connections, connections to suspension systems, anchorage details, and accessories.

## 07 Certificates

Visual Display Boards

Certificate of compliance signed by Contractor attesting that visual display boards conform to the requirements specified.

## 1.3 DELIVERY, STORAGE AND HANDLING

Materials shall be delivered to the building site in the manufacturer's original unopened containers and shall be stored in a clean dry area with temperature maintained above 10 degrees C . Materials shall be stacked according to manufacturer's recommendations. Visual display boards shall be allowed to acclimate to the building temperature for 24 hours prior to installation.

## 1.4 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a one year period shall be provided.

## PART 2 PRODUCTS

## 2.1 PROJECTION SCREEN SURFACES

## 2.1.1 Material and Viewing Surface of Front Projection Screens

Screens shall be manufactured from mildew-and flame-resistant fabric of type indicated for each type of screen specified and complying with the following requirements:

## 2.1.1.1 Viewing Surface

Viewing surface shall be Matte White.

## 2.1.1.2 Seamless Construction

Screens shall be in sizes indicated without seams.

## 2.1.1.3 Fire Performance Characteristics

Projection screen fabrics shall be identical to those materials that have undergone testing and passed requirements for flame resistance and are listed by Underwriter's Laboratory.

## 2.2 ELECTRICALLY OPERATED FRONT PROJECTION SCREENS

## 2.2.1 General

Projection screens shall be manufacturer's standard UL-listed and UL-marked units consisting of case, screen, motor, controls, mounting accessories, and other components required for a complete installation and shall comply with requirements indicated for screen surface and controls and for case, motor, and screen under description of operation and type.

## 2.2.1.1 Single Station Control

Remote control operation of each screen shall be three-position, UL-listed control switch for each screen with metal device box and cover plate for flush wall mounting and for connection to 120 V a.c. power supply.

## 2.2.2 End-Mounted-Motor-Operated Screens with Automatic Ceiling Closure

Projection screens shall be designed and fabricated for recessed installation in ceiling with bottom of case composed of two panels fully enclosing screen and motor, one panel hinged and connected to drive mechanism to open and close automatically when screen is lowered and fully raised and the other panel removable or openable for access to interior of case; and complying with the following requirements:

## 2.2.2.1 Screen Case

Case shall have wood sides and top with metal-lined motor compartment and wood or aluminum bottom panels, factory-primed and constructed as follows:

- a. Bottom panels shall be offset mount to case in position where their bottom surfaces will align flush with finished surface of adjoining ceiling and the bottom edges of case surrounding panels will be recessed by the depth and concealed behind, overlapping ceiling finish.

- b. Top shall be single or double top as standard with manufacturer.

#### 2.2.2.2 Motor

Motor shall be instant reversing, gear drive of size and capacity recommended by screen manufacturer with permanently lubricated ball bearings, automatic thermal overload protection, preset limit switches to automatically stop screen in "up" or "down" positions, and positive stop action to prevent coasting. Motor shall be located in its own compartment on the right or left end of the screen as required for installation.

#### 2.2.2.3 Screen

Screen shall be as indicated below, with top edge mounted on, and securely anchored to, rigid metal roller supported by self-aligning bearings in brackets.

- a. Material shall be vinyl-coated glass fiber fabric.
- b. Size of projection screens is shown on the drawings.

#### 2.2.3 Available Products

Subject to compliance with requirements, electrically operated front projection screens that may be incorporated in the Work include, but are not limited to, the following:

- a. "Executive Electrol", Da-Lite Screen Co., Inc.
- b. "Ambassador", Draper Shade & Screen Co., Inc.

### 2.3 MANUALLY OPERATED FRONT PROJECTION SCREENS

#### 2.3.1 General

Provide manufacturer's standard units consisting of case, screen, mounting accessories and other components as required for a complete installation and complying with descriptive requirements indicated below.

#### 2.3.2 Spring-Roller-Operated Projection Screens

Units designed and fabricated for wall installation. Screen case shall be fabricated in one piece from not less than 22-gage steel with flat back design, vinyl-covered or baked-enamel finish, and end caps with integral roller brackets and furnished with universal mounting brackets in finish matching end caps to enable attachment to wall.

#### 2.3.3 Screen

Provide vinyl-coated glass fiber fabric with top edge mounted on, and securely anchored to, a 3-inch-diameter rigid steel spring roller and bottom edge formed into a pocket holding a tubular metal slat with ends of slat protected by plastic caps and saddle and pull attached to slat by screws. Size of viewing surface shall be 1626 mm high and 2134 mm wide.

#### 2.3.4 Drop Length

Provide extra drop length of 600 mm, black in color and located at top of



screen.

#### 2.3.5 Available Products

Subject to compliance with requirements, manually operated projection screens that may be incorporated in the Work include, but are not limited to, the following:

"Series 500 Auditorium", Bretford Manufacturing, Inc.  
"Model C", Da-lite Screen Co., Inc.  
"Luma 2", Draper Shade & Screen Co.

### PART 3 EXECUTION

#### 3.1 INSTALLATION

##### 3.1.1 General

Installation of projection screens shall be at locations indicated in compliance with screen manufacturer's instructions. Provide steel sub-structure members above ceiling to support projection screens between building structural support members. Screens shall be installed with screen cases in position and relationship to adjoining construction as indicated, securely anchored to supporting substrate, and in manner that produces a smoothly operating screen with plumb and straight vertical edges and plumb and flat viewing surfaces when screen is lowered.

##### 3.1.2 Testing

Electrically operated units shall be tested to verify that screen, controls, limit switches, closure, and other operating components are in optimum functioning condition.

#### 3.2 PROTECTION AND CLEANING

Projection screens shall be protected after installation from damage during construction. If despite such protection damage occurs, damaged components or entire unit shall be removed or replaced as required to provide units in their original, undamaged condition at no expense to the government.

-- End of Section --

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SECTION 10153

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**08/02**

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## SECTION 10153

## TOILET PARTITIONS

08/02

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by basic designation only.

## U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

36 CFR 1191 (1998) ADA Accessibility Guidelines for -  
Buildings and Facilities

## U.S. GENERAL SERVICES ADMINISTRATION (GSA)

CID A-A-60003 (Basic) Partitions, Toilet, Complete

## 1.2 SYSTEM DESCRIPTION

Toilet partition system, including toilet enclosures, room entrance screens, and urinal screens, shall be a complete and usable system of panels, hardware, and support components. The Contractor shall comply with EPA requirements in accordance with Section 01670 RECYCLED / RECOVERED MATERIALS. The partition system shall be provided by a single manufacturer, and shall be a standard product as shown in the most recent catalog data. The partition system shall be as shown.

## 1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

## SD-02 Shop Drawings

Toilet Partition System; G, AE.

Drawings showing plans, elevations, details of construction, hardware, reinforcing, fittings, mountings, and anchorings.

## SD-03 Product Data

Toilet Partition System.

Manufacturer's technical data and catalog cuts including installation and cleaning instructions.

## SD-04 Samples

Toilet Partition System; G, AE.

Manufacturer's standard color charts and color samples.

#### 1.4 DELIVERY, STORAGE, AND HANDLING

Components shall be delivered to the jobsite in the manufacturer's original packaging with the brand, item identification, and project reference clearly marked. Components shall be stored in a dry location that is adequately ventilated; free from dust, water, or other contaminants; and shall have easy access for inspection and handling.

#### 1.5 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a 1 year period shall be provided.

### PART 2 PRODUCTS

#### 2.1 TOILET ENCLOSURES

Toilet enclosures shall conform to CID A-A-60003, Type I, Style B, ceiling hung. Width, length, and height of toilet enclosures shall be as shown. Finish surface of panels shall be solid plastic. Panels indicated to receive toilet paper holders or grab bars as specified in Section 10800A TOILET ACCESSORIES, shall be reinforced for mounting of the items required.

Grab bars shall withstand a bending stress, shear stress, shear force, and a tensile force induced by 1112 N. Grab bars shall not rotate within their fittings.

#### 2.2 URINAL SCREENS

Urinal screens shall conform to CID A-A-60003, Type III, Style A, wall supported. Finish surface of screens shall be solid plastic. Width and height of urinal screens shall be as shown.

#### 2.3 HARDWARE

Hardware for the toilet partition system shall conform to CID A-A-60003 for the specified type and style of partitions. Hardware finish shall be highly resistant to alkalies, urine, and other common toilet room acids. Latching devices and hinges for handicap compartments shall comply with 36 CFR 1191 and shall be chrome-plated steel or stainless steel door latches that operate without either tight grasping or twisting of the wrist of the operator.

#### 2.4 COLORS AND FINISHES

##### 2.4.1 Colors

Color of finishes for toilet partition system components shall be manufacturer's standard as indicated on the Drawings.

### PART 3 EXECUTION

#### 3.1 INSTALLATION

Toilet partitions shall be installed straight and plumb with uniform

clearance of 13 mm between pilasters and panels; 25 mm between pilasters and walls; and not more than 5 mm between pilasters and doors, in accordance with approved manufacturer's instructions with horizontal lines level and rigidly anchored to the supporting construction. Where indicated, anchorage to walls shall be by through-bolting or toggle-bolting.

Drilling and cutting for installation of anchors shall be at locations that will be concealed in the finished work. In the finished work, conceal evidence of drilling in floors and walls. Screws and bolts shall be stainless steel.

### 3.2 ADJUSTING AND CLEANING

Doors shall have a uniform vertical edge clearance of approximately 5 mm and shall rest open at approximately 30 degrees when unlatched. Baked enamel finish shall be touched up with the same color of paint that was used for the finish. Toilet partitions shall be cleaned in accordance with approved manufacturer's instructions and shall be protected from damage until accepted.

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WALL AND CORNER GUARDS

**07/02**

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## SECTION 10260

## WALL AND CORNER GUARDS

07/02

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

## ALUMINUM ASSOCIATION (AA)

AA DAF-45 (1997) Designation System for Aluminum Finishes

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM B 221 (2000) Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes

ASTM D 256 (2000e1) Determining the IZOD Pendulum Impact Resistance of Plastics

ASTM D 635 (1998) Rate of Burning and/or Extent and Time of Burning of Self-Supporting Plastics in a Horizontal Position

## SOCIETY OF AUTOMOTIVE ENGINEERS INTERNATIONAL (SAE)

SAE J1545 (1986) Instrumental Color Difference Measurement for Exterior Finishes, Textiles and Colored Trim

## 1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

## SD-02 Shop Drawings

Corner Guards; G, AE.

Drawings indicating locations and typical elevations of each type of item. Drawings shall show vertical and horizontal dimensions, full size sections, thickness of materials, and fastening details.



## SD-03 Product Data

Corner Guards; G, AE.

Manufacturer's descriptive data, catalog cuts, installation instructions, and recommended cleaning instructions.

## SD-04 Samples

Finish; G, AE.

Manufacturer's standard samples indicating color and texture of materials requiring color and finish selection.

## SD-06 Test Reports

Corner Guards; G, AO.

Fire rating and extinguishing test results for resilient material.

## SD-07 Certificates

Corner Guards; G, AO.

Statements attesting that the items comply with specified fire and safety code requirements.

## 1.3 DELIVERY AND STORAGE

Materials shall be delivered to the project site in manufacturer's original unopened containers with seals unbroken and labels and trademarks intact. Materials shall be kept dry, protected from weather and damage, and stored under cover. Materials shall be stored at approximately 21 degrees C for at least 48 hours prior to installation.

## 1.4 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a 1 year period shall be provided.

## PART 2 PRODUCTS

## 2.1 GENERAL

To the maximum extent possible, corner guards, door and door frame protectors, wall guards (bumper guards), wall panels and wall covering shall be the standard products of a single manufacturer and shall be furnished as detailed. Drawings show general configuration of products required, and items differing in minor details from those shown will be acceptable.

## 2.1.1 Resilient Material

Resilient material shall consist of high impact resistant extruded acrylic vinyl, polyvinyl chloride, or injection molded thermal plastic and shall conform to the following:

## 2.1.1.1 Minimum Impact Resistance

Minimum impact resistance shall be 960.8 N.m/m (18 ft. lb/sq. inch) when tested in accordance with ASTM D 256, (Izod impact, ft. lbs per sq inch notched).

#### 2.1.1.2 Fire Rating

Fire rating shall be Class 1 when tested in accordance with ASTM E 84, having a maximum flame spread of 25 and a smoke developed rating of 450 or less. Material shall be rated self extinguishing when tested in accordance with ASTM D 635. Material shall be labeled and tested by an approved nationally known testing laboratory. Resilient material used for protection on fire rated doors and frames shall be listed by the testing laboratory performing the tests. Resilient material installed on fire rated wood/steel door and frame assemblies shall have been tested on similar type assemblies. Test results of material tested on any other combination of door/frame assembly will not be acceptable.

#### 2.1.1.3 Integral Color

Colored components shall have integral color and shall be matched in accordance with SAE J1545 to within plus or minus 1.0 on the CIE-LCH scales.

### 2.2 CORNER GUARDS

#### 2.2.1 Resilient Corner Guards

Corner guard units shall be flush mounted type, radius formed to profile shown. Corner guards shall extend from floor to ceiling. Mounting hardware, cushions, and base plates shall be furnished. Assembly shall consist of a snap-on corner guard formed from high impact resistant resilient material, minimum 1.98 mm thick, mounted on a continuous aluminum retainer. Extruded aluminum retainer shall conform to ASTM B 221, alloy 6063, temper T5 or T6. Flush mounted type guards shall act as a stop for adjacent wall finish material. Factory fabricated end closure caps shall be furnished for top and bottom of surface mounted corner guards. Flush mounted corner guards installed in fire rated wall shall maintain the rating of the wall. Insulating materials that are an integral part of the corner guard system shall be provided by the manufacturer of the corner guard system. Exposed metal portions of fire rated assemblies shall have a paintable surface.

### 2.3 TRIM, FASTENERS AND ANCHORS

Vinyl trim, fasteners and anchors shall be provided for each specific installation as shown.

### 2.4 FINISH

#### 2.4.1 Aluminum Finish

Finish for aluminum shall be in accordance with AA DAF-45. Exposed aluminum shall be designation AA-C22A31 chemically etched medium matte, with clear anodic coating. Concealed aluminum shall be mill finish as fabricated, uniform in natural color and free from surface blemishes.

#### 2.4.2 Resilient Material Finish

Finish for resilient material shall be embossed texture with colors in

accordance with SAE J1545.

## 2.5 ADHESIVES

Adhesive for resilient material shall be in accordance with manufacturers recommendations.

## 2.6 COLOR

Color shall be as shown on the Drawings.

## PART 3 EXECUTION

### 3.1 INSTALLATION

#### 3.1.1 Corner Guards

Material shall be mounted at location indicated in accordance with manufacturer's recommendations.

-- End of Section --

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## SECTION 10270

## RAISED FLOOR SYSTEM

**01/97**

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## SECTION 10270

RAISED FLOOR SYSTEM  
01/97

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## CEILINGS &amp; INTERIOR SYSTEMS CONTRACTORS ASSOCIATION (CISCA)

CISCA Access Floors (1987) Recommended Test Procedures for Access Floors

## U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FS SS-T-312 (Rev B; Int Am 1; Notice 2; Canc. Notice 1) Tile, Floor: Asphalt, Rubber, Vinyl, and Vinyl Composition

## NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 99 (1999) Health Care Facilities

## UNDERWRITERS LABORATORIES (UL)

UL 779 (1995; Rev thru Jan 1997) Electrically Conductive Floorings

## 1.2 SYSTEM DESCRIPTION

Raised flooring shall be installed at the location and elevation and in the arrangement shown on the drawings. The floor system shall be of the stringer type, complete with all supplemental items, and shall be the standard product of a manufacturer specializing in the manufacture of raised floor systems.

## 1.2.1 Floor Panels

Floor panel testing shall be conducted in accordance with CISCA Access Floors. When tested as specified, all deflection and deformation measurements shall be made at the point of load application on the top surface of the panel. Floor panels shall be capable of supporting 680 kg concentrated load without deflecting more than 2.03 mm and without permanent deformation in excess of 0.25 mm in any of the specified tests. Floor panels shall be capable of supporting 170 kg uniform live load without deflection more than 1.02 mm. Floor panels shall be capable of supporting 272 kg rolling load without deflecting more than 1.02 mm and without permanent deformation in excess of 0.51 mm. In accordance with CISCA Access Floors, the permanent deformation limit under rolling load shall be satisfied in all of the specified tests. In the specified tests,

the permanent deformation shall be measured after 10 passes with Wheel 1 and after 10,000 passes with Wheel 2.

#### 1.2.2 Stringers

Stringers shall be capable of supporting a 113 kg concentrated load at midspan without permanent deformation in excess of 0.25 mm.

#### 1.2.3 Pedestals

Pedestals shall be capable of supporting a 2268 kg axial load without permanent deformation.

#### 1.2.4 Pedestal Adhesive

Adhesive shall be capable of securing a pedestal in place with sufficient bonding strength to resist an overturning force of 113 Nm.

#### 1.2.5 Bond Strength of Factory Installed Floor Covering

Bond strength of floor covering shall be sufficient to permit handling of the panels by use of the panel lifting device, and to withstand moving caster loads up to 454 kg kN, without separation of the covering from the panel.

#### 1.2.6 Leakage

When the space below the finished floor is to be an air plenum, air leakage through the joints between panels and around the perimeter of the floor system shall not exceed 0.15 L/s of air per linear meter of joint subjected to 2.5 mm, water gauge, positive pressure in the plenum.

#### 1.2.7 Grounding

The raised floor system shall be grounded for safety hazard and static suppression.

#### 1.2.8 Blade Rack Support Frames

Provide engineered steel frames to support blade racks independently from raised floor system. Support frames shall be stable and capable of 455 kg per rack gravity load. Design for gravity and seismic loads, with safety factor of three. Bottom of blade racks shall match raised floor elevation.

Frames shall not interfere with air flow below floor and into rack.

### 1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Raised Floor System; G, AE.

Drawings showing layout of the work, sizes and details of components, details at floor perimeter, bracing to resist seismic



or other lateral loads, typical cutout details including size and shape limitation, method of grounding, description of shop coating, and installation height above structural floor.

#### SD-03 Product Data

Raised Floor System; G, AE.

Manufacturer's descriptive data, catalog cuts, and installation instructions. The data shall include information about any design and production techniques, procedures and policies used to conserve energy, reduce material, improve waste management or incorporate green building/recycled products into the manufacturer of their components or products. Cleaning and maintenance instructions shall be included. Design calculations which demonstrate that the proposed floor system meets requirements for seismic loading, prepared in accordance with subparagraph Underfloor Bracing under paragraph PANEL SUPPORT SYSTEM and ICBO UBC. Certified copies of test reports may be submitted in lieu of calculations.

#### SD-04 Samples

Raised Floor System; G, AE.

One sample of each panel type and suspension system proposed for use.

#### SD-06 Test Reports

Tests.  
Testing of Electrical Resistance.

Certified copies of test reports from an approved testing laboratory, attesting that the proposed floor system components meet the performance requirements specified.

#### SD-07 Certificates

Raised Floor System.

Certificate of compliance attesting that the raised floor system meets specification requirements.

#### SD-08 Calculations

Calculations; G, AE.

Submit Calculations stamped by a Colorado Registered Professional Engineer for the structural design of the panels, stringers, pedestals, and blade rack support frames.

### 1.4 DELIVERY, STORAGE, AND HANDLING

Materials shall be stored in original protective packaging in a safe, dry, and clean location and shall be handled in a manner to prevent damage. Panels shall be stored at temperatures between 4 and 32 degrees C, and between 20 percent and 70 percent humidity.

## 1.5 EXTRA MATERIALS

Spare floor panels, spare complete pedestal assemblies, and spare stringers shall be furnished at the rate of one space for each 100 or fraction thereof required.

## 1.6 OPERATION AND MAINTENANCE MANUALS

Provide maintenance instructions for proper care of the floor panel surface. When conductive flooring is specified, require submittal of maintenance instructions to identify special cleaning and maintenance requirements to maintain "conductivity" properties of the panel finish.

## PART 2 PRODUCTS

### 2.1 FLOOR PANELS

#### 2.1.1 Panel Construction

Except for edge panels, panel size shall be 600 by 600 mm. Finished panels shall be within a 0.25 mm tolerance of the nominal size, and shall be square within a tolerance of 0.38 mm measured corner-to-corner. The top surface of panels shall be flat within a 0.51 mm tolerance measured corner-to-corner. Panels shall be permanently marked to indicate load rating and model number.

##### 2.1.1.1 Hollow Formed Steel Panels

Steel panels shall be of die-formed construction, consisting of a flat steel top sheet welded to one or more formed steel stiffener sheets. Panels shall be chemically cleaned, bonderized, and painted with the manufacturer's standard finish.

##### 2.1.1.2 Concrete Panels

Concrete panels shall be of lightweight structural concrete with either structural reinforcing or a die-formed, electro-galvanized steel bottom pan. All concrete surfaces including those resulting from field cuts shall be sealed with the manufacturer's standard sealer before covering the surfaces with other materials.

#### 2.1.2 Floor Covering

Floor panels shall be surfaced with materials firmly bonded in place with waterproof adhesive. The electrical resistance shall remain stable over the life expectancy of the floor covering. Any antistatic agent used in the manufacturing process shall be an integral part of the material, and shall not be surface applied. Bolt heads or similar attachments shall not rise above the traffic surface.

##### 2.1.2.1 Carpet

Carpet surfacing shall be field installed using one full carpet square per panel. Carpet shall be nylon filament with a loop pile refer to Section 09680 for additional information.

##### 2.1.2.2 Conductive High Pressure Laminate

Conductive high pressure laminate floor surfacing shall conform to FS SS-T-312, Type III, Vinyl Tile and UL 779. The total system electrical

resistivity from the wearing surface of the floor to the ground connection shall be between 25,000 ohms and 1,000,000 ohms.

#### 2.1.3 Edge Strip

Panels shall be edged with extruded vinyl edge strips secured in place with mechanical interlock or adhesive bond, or shall be of a replaceable type. Top of strip shall be approximately 3 mm wide, and shall be flush with the floor surfacing.

#### 2.1.4 Accessories

Registers, grilles, perforated panels, and plenum dividers shall be provided where indicated, and shall be the manufacturer's standard type. Registers, grilles, and perforated panels shall be designed to support the same static loads as floor panels without structural failure, and shall be capable of delivering the air volumes indicated. Registers and perforated panels shall be 25 percent open area and shall be equipped with adjustable dampers.

#### 2.1.5 Resilient Base

Base shall be manufacturers standard straight style (installed with carpet) and coved style (installed with resilient flooring). Base shall be 100 mm high and a minimum 3 mm thick. Preformed outside corners shall be furnished.

#### 2.1.6 Lifting Device

Each individual room shall be provided with one floor panel lifting device standard with the floor manufacturer. A minimum of two devices shall be furnished.

#### 2.1.7 Core Plugs and Grommets

Factory cored panels to receive carpet shall be provided with removable hole plugs which are flush with the panel surface so as not to interfere with carpet surfacing. 100 circular grommets and lids with adjustable cable slot shall be provided and turned over to the Contracting Officer. Factory cored panels with high pressure laminate surfacing shall be furnished with circular grommets and lids with adjustable cable slot.

### 2.2 PANEL SUPPORT SYSTEM

#### 2.2.1 Pedestals

Pedestals shall be of steel or aluminum or a combination thereof. Ferrous materials shall have a factory-applied corrosion-resistant finish. Pedestal base plates shall provide a minimum of 10,300 square millimeter of bearing surface and shall be a minimum of 3 mm thick. Pedestal shafts shall be threaded to permit height adjustment within a range of approximately 50 mm, to permit overall floor adjustment within plus or minus 2.5 mm of the required elevation, and to permit leveling of the finished floor surface within 1.56 mm in 3000 mm in all directions. Locking devices shall be provided to positively lock the final pedestal vertical adjustments in place. Pedestal caps shall interlock with panels to preclude tilting or rocking of the panels.

#### 2.2.2 Stringers

Stringers shall be of rolled steel or extruded aluminum, and shall interlock with the pedestal heads to prevent lateral movement.

#### 2.2.3 Underfloor Bracing

Special bracing to resist the effects of seismic or other forces shall be in accordance with Section 13080 SEISMIC PROTECTION FOR MISCELLANEOUS EQUIPMENT.

#### 2.3 FASCIA

Aluminum or steel fascia plates shall be provided at open ends of floor, at sides of ramps and steps, and elsewhere as required to enclose the free area under the raised floor. Steel plates shall have a factory applied baked enamel finish. Finish on aluminum plates shall be as standard with the floor system manufacturer. Fascia plates shall be reinforced on the back, and shall be supported using the manufacturer's standard lateral bracing at maximum 1200 mm on center. Trim, angles, and fasteners shall be provided as required.

#### 2.4 TESTS

Raised flooring shall be factory tested by an independent laboratory at the same position and maximum design elevation and in the same arrangement as shown on the drawings for installation so as to duplicate service conditions as much as possible.

##### 2.4.1 Load Tests

Floor panel, stringer, and pedestal testing shall be conducted in accordance with CISCA Access Floors.

#### 2.5 Test for Bond Strength of Factory Installed Floor Covering

The test panel shall be supported on pedestals and stringers as specified for the installed floor. The supports shall be braced as necessary to prevent sideways movement during the test. A test load of 4.45 kN shall be imposed on the test assembly through a hard plastic caster 75 mm in diameter and 25 mm wide. The caster shall be rolled completely across the center of the panel. The panel shall withstand 20 passes of the caster with no delamination or separation of the covering.

#### 2.6 COLOR

Color shall be as indicated on the Drawings.

#### 2.7 BLADE RACK SUPPORT FRAMES

Blade rack support frames shall be steel with a corrosion-resistant finish.

### PART 3 EXECUTION

#### 3.1 INSTALLATION

The floor system shall be installed in accordance with the manufacturer's instructions and with the approved detail drawings. Open ends of the floor, where the floor system does not abut wall or other construction, shall have positive anchorage and rigid support. Areas to receive raised

flooring shall be maintained between 16 and 32 degrees C, and between 20 percent and 70 percent humidity for 24 hours prior to and during installation.

#### 3.1.1 Preparation for Installation

The area in which the floor system is to be installed shall be cleared of all debris. Structural floor surfaces shall be thoroughly cleaned and all dust shall be removed. Floor coatings required for dust or vapor control shall be installed prior to installation of pedestals only if the pedestal adhesive will not damage the coating. If the coating and adhesive are not compatible, the coating shall be applied after the pedestals have been installed and the adhesive has cured.

#### 3.1.2 Pedestals

Pedestals shall be accurately spaced, and shall be set plumb and in true alignment. Base plates shall be in full and firm contact with the structural floor, and shall be secured to the structural floor with adhesive and finally shall be secured to the structural floor with steel expansion anchors.

#### 3.1.3 Stringers

Stringers shall be interlocked with the pedestal caps to preclude lateral movement, and shall be spaced uniformly in parallel lines at the indicated elevation.

#### 3.1.4 Auxiliary Framing

Auxiliary framing or pedestals shall be provided around columns and other permanent construction, at sides of ramps, at open ends of the floor, and beneath panels that are substantially cut to accommodate utility systems. Special framing for additional lateral support shall be as shown on the approved detail drawings.

#### 3.1.5 Blade Rack Support Frames

Install frames in accordance with approved submittal drawings. Coordinate installation of frames with rack design and surrounding raised floor system. Install frames square and plumb. Fasten to concrete floor slab. Provide rigid, stable installation that is flush with surrounding raised floor, with gaps between frame and floor panels no greater than 3 mm.

#### 3.1.6 Panels

The panels shall be interlocked with supports in a manner that will preclude lateral movement. Perimeter panels, cutout panels, and panels adjoining columns, stairs, and ramps must be fastened to the supporting components to form a rigid boundary for the interior panels. Floors shall be level within 2 mm measured with a 250 mm straightedge in all directions. Cut edges of steel and wood-core panels shall be painted as recommended by the panel manufacturer. Cut edges of composite panels shall be coated with a silicone rubber sealant or with an adhesive recommended by the panel manufacturer. Extruded vinyl edging shall be secured in place at all cut edges of all panel cut-outs to prevent abrasion of cables. Where the space below the floor is a plenum, cutouts for conduit and similar penetrations shall be closed using self-extinguishing sponge rubber.

### 3.1.7 Resilient Base

Base shall be provided at vertical wall intersections. Cracks and voids in walls and other vertical surfaces to receive base shall be filled with an approved filler. The base shall be applied after the floor system has been completely installed. Base shall be applied with adhesive in accordance with the manufacturer's recommendations.

### 3.1.8 Repair of Zinc Coating

Zinc coating that has been damaged, and cut edges of zinc-coated components and accessories, shall be repaired by the application of a galvanizing repair paint. Areas to be repaired shall be thoroughly cleaned prior to application of the paint.

## 3.2 TESTING OF ELECTRICAL RESISTANCE

Testing of electrical resistance in the completed installation shall be conducted in the presence of the Contracting Officer. Testing shall be in accordance with NFPA 99 modified by placing one electrode on the center of the panel surface and connecting the other electrode to the metal flooring support. Measurements shall be made at five or more locations. Each measurement shall be the average of five readings of 15 seconds duration at each location. During the tests, relative humidity shall be 45 to 55 percent and temperature shall be 21 to 24 degrees C. The panels used in the testing will be selected at random and will include two panels most distant from the ground connection. Electrical resistance shall be measured with instruments that are accurate within 2 percent and that have been calibrated within 60 days prior to the performance of the resistance tests. The metal-to-metal resistance from panel to supporting pedestal shall not exceed 10 ohms. The resistance between the wearing surface of the floor covering and the ground connection, as measured on the completed installation, shall be in accordance with paragraph FLOOR COVERING.

## 3.3 CLEANING AND PROTECTION

### 3.3.1 Cleaning

The space below the completed floor shall be free of all debris. Before any traffic or other work on the completed raised floor is started, the completed floor shall be cleaned in accordance with the floor covering manufacturer's instructions.

### 3.3.2 Protection

Traffic areas of raised floor systems shall be protected with a covering of building paper, fiberboard, or other suitable material to prevent damage to the surface. Cutouts shall be covered with material of sufficient strength to support the loads to be encountered. Plywood or similar material shall be placed on the floor to serve as runways for installation of heavy equipment. Protection shall be maintained until the raised floor system is accepted.

## 3.4 FIRE SAFETY

An automatic detection system shall be installed below the raised floor meeting the requirements of NFPA 75 paragraph 5-2.1 and shall sound an audible and visual alarm. Air space below the raised floor shall be subdivided into areas not exceeding 929 squared meters by tight,

noncombustible bulkheads. All penetrations for piping and cables shall be sealed to maintain bulkhead properties.

-- End of Section --

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SECTION 10440

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**07/02**

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## SECTION 10440

## INTERIOR SIGNAGE

07/02

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)

AAMA 605 (1998) Voluntary Specification,  
Performance Requirements and Test  
Procedures for High Performance Organic  
Coatings on Aluminum Extrusions and Panels

## AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z97.1 (1984; R 1994) Safety Performance  
Specifications and Methods of Test for  
Safety Glazing Materials Used in Buildings

## 1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

## SD-02 Shop Drawings

Detail Drawings; G, AE.

Drawings showing elevations of each type of sign, dimensions, details and methods of mounting or anchoring, shape and thickness of materials, and details of construction. A schedule showing the location, each sign type, and message shall be included. Include table listing signage room numbers with corresponding drawing room numbers.

## SD-03 Product Data

Installation.

Manufacturer's descriptive data, catalogs cuts, installation and cleaning instructions.

## SD-04 Samples

Interior Signage; G, AE.

One sample of each of the following sign types showing typical quality and workmanship. The samples may be installed in the work, provided each sample is identified and location recorded.

a. Door identification sign.

Two samples of manufacturer's standard color chips for each material requiring color selection.

### 1.3 GENERAL

Interior signage shall be of the design, detail, sizes, types, and message content shown on the drawings, shall conform to the requirements specified, and shall be provided at the locations indicated. Signs shall be complete with lettering, framing as detailed, and related components for a complete installation.

#### 1.3.1 Character Proportions and Heights

Letters and numbers on indicated signs in handicapped-accessible buildings, which do not designate permanent rooms or spaces, shall have a width-to-height ratio between 3:5 and 1:1 and a stroke-width-to-height ratio between 1:5 and 1:10. Characters and numbers on indicated signs shall be sized according to the viewing distance from which they are to be read. The minimum height is measured using an upper case letter "X". Lower case characters are permitted. Suspended or projected overhead signs shall have a minimum character height of 75 mm.

#### 1.3.2 Raised and Brailled Characters and Pictorial Symbol Signs (Pictograms)

Letters and numbers on indicated signs which designate permanent rooms and spaces in handicapped-accessible buildings shall be raised 0.8 mm upper case, sans serif or simple serif type and shall be accompanied with Grade 2 Braille. Raised characters shall be at least 16 mm in height, but no higher than 50 mm. Pictograms shall be accompanied by the equivalent verbal description placed directly below the pictogram. The border dimension of the pictogram shall be 152 mm minimum in height. Indicated accessible facilities shall use the international symbol of accessibility.

### 1.4 QUALIFICATIONS

Signs, plaques, and dimensional letters shall be the standard product of a manufacturer regularly engaged in the manufacture of such products and shall essentially duplicate signs that have been in satisfactory use at least 2 years prior to bid opening.

### 1.5 DELIVERY AND STORAGE

Materials shall be delivered to the jobsite in manufacturer's original packaging and stored in a clean, dry area in accordance with manufacturer's instructions.

## PART 2 PRODUCTS

### 2.1 ROOM IDENTIFICATION/DIRECTIONAL SIGNAGE SYSTEM

Signs shall be fabricated of acrylic plastic conforming to ANSI Z97.1.

### 2.1.1 Standard Room Signs

Signs shall consist of matte finish acrylic plastic. Corners of signs shall be 19 mm radius. Obtain final room numbers and room names from Contracting Officer's Representative.

### 2.1.2 Changeable Message Strip Signs

Changeable message strip signs shall consist of cast acrylic Type ESplastic captive message slider sign face with message slots and associated end caps, as detailed, for insertion of changeable message strips. Obtain message information from Contracting Officer's Representative. Size of signs shall be as shown on the drawings. Individual message strips to permit removal, change, and reinsertion shall be provided as detailed. Corners of signs shall be 19 mm radius.

### 2.1.3 Type of Mounting For Signs

Extruded aluminum brackets, mounted as shown, shall be furnished for hanging, projecting, and double-sided signs. Mounting for framed, hanging, and projecting signs shall be by mechanical fasteners. Surface mounted signs shall be provided with 1.6 mm thick vinyl foam tape or countersunk mounting holes in plaques and mounting screws. Sign inserts shall be provided with 1.6 mm thick foam tape.

### 2.1.4 Graphics

Signage graphics for modular identification/directional signs shall conform to the following:

Pressure sensitive prespaced and prealigned precision computer cut vinyl letters on release paper shall be provided. Edges and corners of finished letter forms and graphics shall be true and clean. Vinyl sheeting for graphics shall be 5 to 7 year premium type and shall be a minimum 0.08 mm film thickness. Film shall include a precoated pressure sensitive adhesive backing.

Graphics shall be raised 0.8 mm with background painted with low VOC paint or engraved exposed laminate.

## 2.2 ORGANIC COATING

Organic coating shall conform to AAMA 605, with total dry film thickness not less than 0.030 mm.

## 2.3 FABRICATION AND MANUFACTURE

### 2.3.1 Factory Workmanship

Holes for bolts and screws shall be drilled or punched. Drilling and punching shall produce clean, true lines and surfaces. Exposed surfaces of work shall have a smooth finish and exposed riveting shall be flush. Fastenings shall be concealed where practicable.

### 2.3.2 Dissimilar Materials

Where dissimilar metals are in contact, the surfaces will be protected to prevent galvanic or corrosive action.

## 2.4 COLOR, FINISH, AND CONTRAST

Color shall be as shown on the Drawings. In buildings required to be handicapped-accessible, the characters and background of signs shall be eggshell, matte, or other non-glare finish. Characters and symbols shall contrast with their background - either light characters on a dark background or dark characters on a light background.

## PART 3 EXECUTION

### 3.1 INSTALLATION

Signs shall be installed in accordance with approved manufacturer's instructions at locations shown on the detail drawings. Illuminated signage shall be in conformance with the requirements of Section 16415 ELECTRICAL WORK, INTERIOR. Signs shall be installed plumb and true at mounting heights indicated, and by method shown or specified. Required blocking shall be installed as detailed. Signs which designate permanent rooms and spaces in handicapped-accessible buildings shall be installed on the wall adjacent to the latch side of the door. Where there is no wall space to the latch side of the door, including at double leaf doors, signs shall be placed on the nearest adjacent wall. Mounting location for such signage shall be so that a person may approach within 75 mm of signage without encountering protruding objects or standing within the swing of a door. Signs on doors or other surfaces shall not be installed until finishes on such surfaces have been installed. Signs installed on glass surfaces shall be installed with matching blank back-up plates in accordance with manufacturer's instructions.

#### 3.1.1 Anchorage

Anchorage shall be in accordance with approved manufacturer's instructions. Anchorage not otherwise specified or shown shall include slotted inserts, expansion shields, and powder-driven fasteners when approved for concrete; toggle bolts and through bolts for masonry; machine carriage bolts for steel; lag bolts and screws for wood. Exposed anchor and fastener materials shall be compatible with metal to which applied and shall have matching color and finish. Where recommended by signage manufacturer, foam tape pads may be used for anchorage. Foam tape pads shall be minimum 2 mm thick closed cell vinyl foam with adhesive backing. Adhesive shall be transparent, long aging, high tech formulation on two sides of the vinyl foam. Adhesive surfaces shall be protected with a 0.13 mm green flatstock treated with silicone. Foam pads shall be sized for the signage as per signage manufacturer's recommendations. Signs mounted to painted gypsum board surfaces shall be removable for painting maintenance. Signs mounted to lay-in ceiling grids shall be mounted with clip connections to ceiling tees.

#### 3.1.2 Protection and Cleaning

The work shall be protected against damage during construction. Hardware and electrical equipment shall be adjusted for proper operation. Glass, frames, and other sign surfaces shall be cleaned in accordance with the manufacturer's approved instructions.

-- End of Section --

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SECTION 10508

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## SECTION 10508

## METAL LOCKERS

## PART 1 GENERAL

## 1.1 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

## SD-02 Shop Drawings

Metal Lockers.

Furnish installation details. The manufacturer's printed literature will be acceptable in lieu of detail drawings provided this literature accurately shows the items proposed to be furnished and the method of installation.

## SD-03 Product Data

Metal Lockers.

## SD-04 Samples

Metal Lockers; G, AE.

Manufacturer's standard color charts and color samples.

## 1.2 QUALITY ASSURANCE

Source Limitations: Obtain locker units and accessories through one source from a single manufacturer.

## 1.3 DELIVERY, STORAGE, AND HANDLING

Do not deliver lockers until spaces to receive them are clean, dry, and ready for locker installation.

Protect lockers from damage during deliver, handling, storage, and installation.

## PART 2 PRODUCTS

## 2.1 METAL LOCKERS

Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the products indicated in the Metal Locker Schedule at the end of Part 3.

## 2.2 FABRICATION



Provide knocked-down or welded fabrication as indicated in the Metal Locker Schedule at the end of Part 3.

#### 2.2.1 Unit Principle

Fabricate each locker with an individual door and frame, individual top, bottom, back, and shelves, and common intermediate uprights separating compartments.

#### 2.2.2 Knocked-Down Construction

Fabricate lockers for nominal assembly at Project site.

#### 2.2.3 All-Welded Construction

Preassemble lockers by welding all joints, seams, and connections, with no bolts, screws, or rivets used in assembly. Grind exposed welds flush.

#### 2.2.4 Fabrication

Fabricate lockers square, rigid, and without warp, with metal faces flat and free of dents or distortion. Make exposed metal edges free of sharp edges and burrs, and safe to touch. Weld frame members together to form a rigid, one-piece assembly.

1. Form locker-body panels, doors, shelves and accessories from one-piece steel sheet, unless otherwise indicated.

### 2.3 FINISHES, GENERAL

#### 2.3.1 Finish Steel

Finish all steel surfaces and accessories, except prefinished stainless-steel and chrome-plate surfaces. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping. Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

### 2.4 STEEL SHEET FINISHES

#### 2.4.1 Surface Preparation

Clean surfaces of dirt, oil, grease, mill scale, rust and other contaminants that could impair bond. Use manufacturer's standard methods.

#### 2.4.2 Baked-Enamel Finish

Immediately after cleaning and pretreating, apply manufacturer's standard baked-enamel finish consisting of a thermosetting topcoat. Comply with paint manufacturer's written instructions for applying and baking to achieve a minimum dry film thickness of 0.036 mm on doors, frames, and legs, 0.028 mm elsewhere.

## PART 3 EXECUTION

## 3.1 INSTALLATION

Metal lockers shall not be installed until after the room painting and finishing operations are complete. Damaged, spotted, or otherwise defective lockers shall be removed and replaced with new lockers or repaired to the original state at no additional cost to the Government.

## 3.2 SCHEDULE

Metal lockers shall be provided in rooms noted on the drawings. Locker Types are as indicated below.

## METAL LOCKER SCHEDULE

A. Metal Locker LL-1: Where metal lockers of this designation are indicated, provide products complying with the following:

1. Products: Available products include the following:
  - a. Lyon Standard Quiet Locker
2. Material: Cold-rolled steel sheet
3. Back-Material Thickness: 24 ga.
4. Side Material Thickness: 24 ga.
5. Door-Material Thickness: 16 ga.
6. Locker Fabrication: Knocked down, with welded door frame
7. Locker Arrangement: Door per frame with 152 mm closed style base and sloping top one.
8. Backs: Solid
9. Sides: Solid
10. Door Style: Flush with louvered vents
11. Shelves: Not required
12. Hinges: Standard hinge
13. Handles/Latches: Recessed with padlock hasp and quiet latching mechanism.
14. Size: Height: 1829 mm, Width: 305 mm, Depth: 381 mm.
15. Color: As indicated on the drawings.

B. Metal Locker LL-2: Where metal lockers of this designation are indicated, provide products complying with the following:

1. Products: Available products include the following:
  - a. Lyon Standard Quiet Locker
2. Material: Cold-rolled steel sheet
3. Back-Material Thickness: 24 ga.
4. Side Material Thickness: 24 ga.
5. Door-Material Thickness: 16 ga.
6. Locker Fabrication: Knocked down, with welded door frame
7. Locker Arrangement: Multiple tier - 2 doors per frame with 152 mm closed style base and sloping top.
8. Backs: Solid
9. Sides: Solid
10. Door Style: Flush with louvered vents
11. Shelves: Not required

- 12. Hinges: Standard hinge
- 13. Handles/Latches: Recessed with padlock hasp and quiet latching mechanism.
- 14. Size: Height: 1829 mm, Width: 305 mm, Depth: 381 mm.
- 15. Color: As indicated on the drawings.

-- End of Section --

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SECTION 10650

OPERABLE PARTITIONS

**08/00**

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## SECTION 10650

## OPERABLE PARTITIONS

08/00

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM E 84	(1999) Surface Burning Characteristics of Building Materials
ASTM E 90	(1999) Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions
ASTM E 413	(1987; R 1999) Rating Sound Insulation

## 1.2 GENERAL REQUIREMENTS

The Contractor shall supply and install flat wall, manual operation, acoustical operable partitions as shown on the drawings including all hardware, seals, track and rollers as needed to close the specified opening. The partition shall be made up of a series of rigid, flat wall panels; each panel being a one-piece assembly nominally 1.2 m wide. Unless otherwise specified, the wall shall comprise the least number of panels. The mechanical seal of the panel shall actuate with a single operating action.

## 1.2.1 Manual Operation

The manual operation shall be accomplished with less than 89 N force to start movement at the rate of 1.02 m/s. A removable handle shall be used to extend and retract the bottom operable seals; vertical movement of seals shall be 50 mm. Closure to the lead wall shall be by use of a flexible bulb; final closing shall be accomplished by means of a lever exerting pressure against wall.

## 1.3 SUBMITTALS

All items designated with a G, including product literature, calculations, component data, certificates, diagrams and drawings, shall be submitted concurrently in one complete system submittal. Omission of any required submittal item from the package shall be sufficient cause for disapproval of the entire submittal. Unless otherwise indicated in the submittal review commentary, disapproval of any item within the package shall require a re-submittal of the entire system package, in which all deficiencies shall be corrected. Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for

information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

#### SD-02 Shop Drawings

Operable Partitions; G, AE.

Drawings containing complete schematic diagrams and details required to demonstrate that the system has been coordinated and will properly function as a unit. Drawings shall show proposed layout and anchorage of equipment and appurtenances, and equipment relationship to other parts of the work including clearances for maintenance and operation.

#### SD-03 Product Data

Operable Partitions.

Manufacturer's descriptive data, performance charts, catalog cuts, and installation instructions.

#### SD-04 Samples

Operable Partitions; G, AE.

Color samples of specified surfaces and finishes to match those specified. Finish and color requirements shall not be limited to manufacturer's standard selections in order to meet these requirements.

#### SD-07 Certificates

Materials.

Operable Partitions.

Certificate attesting that the materials meet the requirements specified and that partitions have specified acoustical and flame retardant properties, as determined by test.

#### SD-10 Operation and Maintenance Data

Operable Partitions.

Six complete copies of operating instructions outlining the procedures required for partitions. The instructions shall include the manufacturer's name, model number, service manual, parts list, and brief description of all equipment and operating features. Data shall include a complete list of parts and supplies, with current unit prices and source of supply, and a list of the parts recommended by the manufacturer to be replaced after 1 year and 3 years of service. Six complete copies of maintenance instructions explaining routine maintenance procedures including inspection, adjustments, lubrication, and cleaning. The instructions shall list possible breakdown, methods of repair, and a troubleshooting guide.

### 1.4 DELIVERY AND STORAGE

Materials shall be delivered to the jobsite in the manufacturer's original, unopened packages and shall be stored with protection from the weather, humidity and temperature variations, dirt and dust, or other contaminants.

## 1.5 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a 1 year period shall be provided.

## PART 2 PRODUCTS

### 2.1 MATERIALS

Material and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of such products and shall essentially duplicate items that have been in satisfactory use for at least 2 year prior to bid opening. Equipment shall be supported by a service organization that is, in the opinion of the Contracting Officer, reasonably convenient to the site. Door and partition finishes shall have a Class A rating when tested in accordance with ASTM E 84.

#### 2.1.1 Panel Surface Finish

Panel surface finish shall be fabric of 100 percent polyester. Pile height shall be minimum 2.5 mm thickness. Color shall match that listed on the drawings.

#### 2.1.2 Hardware

Operable partitions shall have manufacturer's standard hardware. Hardware shall be anodized aluminum with a natural finish, chrome plated or brass plated metal, or painted finish.

#### 2.1.3 Sweep Strips

Sweep strips shall be vinyl or other material which will not crack or craze with severe usage. Sweep strip shall control STC to the specified rating.

#### 2.1.4 Track

Track shall be recessed as shown and shall be of extruded aluminum or enamel finish steel. Track shall be manufacturer's standard product designed for the weight of the finished partition, including door. Track sections shall be provided in the maximum lengths practicable, not less than 1.8 m long except for narrow doors and at ends of runs where short length is required. Suitable joint devices such as interlocking keys shall be provided at each joint to provide permanent alignment of track.

#### 2.1.5 Metal Soffit

Soffit shall be provided when steel track is recessed. Soffit shall be of metal of adequate thickness to protect the ceiling from damage by door operation and shall be provided with the door manufacturer's standard neutral-color applied finish. Soffit on aluminum track shall be an integral part of the track.

#### 2.1.6 Vinyl Restrictions



Vinyls shall contain a non-mercury based mildewcide and shall be manufactured without the use of cadmium-based stabilizers.

## 2.2 OPERABLE PARTITIONS

Operable partitions shall consist of top hung ball bearing carriers which support paired modular panels. Partition finish shall have a flame spread rating of not more than 25 in accordance with ASTM E 84.

### 2.2.1 Panels

Panels shall be constructed of minimum 1.9 mm thick steel frames with minimum 0.80 mm thick face panels spot welded to the frame. Panels shall be not more than 1.2 m wide, except for end closure panels, and shall be full height to track. Panels shall lock in place to form a stable, rigid partition; low profile hinges shall project 6 mm maximum from panel edge. Panels shall be surfaced with wall carpet which wraps around the vertical panel edges without vertical trim. Panel thickness (100 mm nominal) and composition shall be designed to provide an STC rating of not less than 50 in accordance with ASTM E 90 and ASTM E 413.

### 2.2.2 Doors

Doors shall have vinyl sweep top seals which compress against the bottom of the top track. Doors shall be nonfire rated and shall be manually operated.

### 2.2.3 Seals

Bottom seals shall consist of a vinyl sweep mechanical seal which will expand in place or shall be accomplished by using panels which can be lowered by a removable operating device. Vertical seal between panels shall be anodized, architectural grade, aluminum extrusion with vinyl sound seal.

## 2.3 COLOR

Color shall be as shown on the Drawings.

## PART 3 EXECUTION

### 3.1 INSTALLATION

Installation shall be in accordance with the manufacturer's approved installation instructions. Electrical work shall conform to Section 16415 ELECTRICAL WORK, INTERIOR.

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## SECTION 10800

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**07/02**

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## SECTION 10800

## TOILET ACCESSORIES

07/02

## PART 1 GENERAL

## 1.1 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

## SD-03 Product Data

Finishes.  
Accessory Items.

Manufacturer's descriptive data and catalog cuts indicating materials of construction, fasteners proposed for use for each type of wall construction, mounting instructions, operation instructions, and cleaning instructions.

## SD-04 Samples

Finishes; G, AE.  
Accessory Items; G, AE.

One sample of each accessory proposed for use. Approved samples may be incorporated into the finished work, provided they are identified and their locations noted.

## SD-07 Certificates

Accessory Items

Submit for each type of accessory specified, attesting that the items meet the specified requirements.

## 1.2 DELIVERY, STORAGE, AND HANDLING

Toilet accessories shall be wrapped for shipment and storage, delivered to the jobsite in manufacturer's original packaging, and stored in a clean, dry area protected from construction damage and vandalism.

## 1.3 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a 1 year period shall be provided.

## PART 2 PRODUCTS

## 2.1 MANUFACTURED UNITS

Toilet accessories shall be provided where indicated in accordance with paragraph SCHEDULE. Each accessory item shall be complete with the necessary mounting plates and shall be of sturdy construction with corrosion resistant surface.

### 2.1.1 Anchors and Fasteners

Anchors and fasteners shall be capable of developing a restraining force commensurate with the strength of the accessory to be mounted and shall be suited for use with the supporting construction. Exposed fasteners shall be of tamperproof design and shall be finished to match the accessory.

### 2.1.2 Finishes

Except where noted otherwise, finishes on metal shall be provided as follows:

<u>Metal</u>	<u>Finish</u>
Stainless steel	No. 4 satin finish
Carbon steel, copper alloy, and brass	Chromium plated, bright

## 2.2 ACCESSORY ITEMS

Accessory items shall conform to the requirements specified below.

### 2.2.1 Grab Bar (GB)

Grab bar shall be 18 gauge, 32 mm OD Type 304 stainless steel. Grab bar shall be form and length as indicated. Concealed mounting flange shall have mounting holes concealed. Grab bar shall have peened non-slip surface. Installed bars shall be capable of withstanding a 2.225 kN vertical load without coming loose from the fastenings and without obvious permanent deformation. Space between wall and grab bar shall be 38 mm.

### 2.2.2 Mirrors, Glass (MG)

Refer to Section 08810 GLASS AND GLAZING.

### 2.2.3 Combination Paper Towel Dispenser/Waste Receptacle Units (PTDWR)

Dispenser/receptacle shall be semi-recessed and shall have a capacity of 100 sheets of C-fold, single-fold, or quarter-fold towel. Waste receptacle shall be designed to be locked in unit and removable for service. Locking mechanism shall be tumbler key lock. Waste receptacle shall have a capacity of 68 L. Unit shall be fabricated of not less than 0.8 mm stainless steel welded construction with all exposed surfaces having a satin finish. Waste receptacle that accepts reusable liner standard for unit manufacturer shall be provided.

### 2.2.4 Sanitary Napkin Disposer (SND)

Sanitary napkin disposal shall be constructed of Type 304 stainless steel with removable leak-proof receptacle for disposable liners. 100

disposable liners of the type standard with the manufacturer shall be provided. Receptacle shall be retained in cabinet by tumbler lock. Disposer shall be provided with a door for inserting disposed napkins, and shall be partition mounted.

#### 2.2.5 Shower Curtain (SC)

Shower curtain shall be sized to suit conditions. Curtain shall be anti-bacterial nylon/vinyl fabric. Color shall be white.

#### 2.2.6 Shower Curtain Rods (SCR)

Shower curtain rods shall be Type 304 stainless steel 32 mm OD by 1.24 mm minimum straight to meet installation conditions.

#### 2.2.7 Soap Dispenser (SD)

Soap dispenser shall be lavatory mounted, liquid type consisting of an undercounter replaceable 7-liter cartridge serving all lavatories in counter, in lockable stainless steel enclosure, and a 100 mm chrome painted spout.

#### 2.2.8 Shelf, Metal, Light Duty (SM)

Light duty metal shelf shall be supported between brackets or on brackets. Brackets shall prevent lateral movement of the shelf. Shelf shall be 203 x 1219 mm. Shelf and brackets shall be stainless steel.

#### 2.2.9 Soap and Grab Bar Combination, Recessed (SGR)

Soap and grab bar combination shall be recessed type and shall be Type 304 stainless steel, bright polished finish.

#### 2.2.10 Towel Bar (TB)

Towel bar shall be stainless steel with a minimum thickness of 0.38 mm. Bar shall be minimum 19 mm diameter, or 16 mm square. Finish shall be bright polish.

#### 2.2.11 Towel Pin (TP)

Towel pin shall have concealed wall fastenings, and a pin integral with or permanently fastened to wall flange. Maximum projection shall be 100 mm. Design shall be consistent with design of other accessory items. Finish shall be bright polish.

#### 2.2.12 Toilet Tissue Dispenser (TTD)

Toilet tissue holder shall be Type II - surface mounted. Cabinet shall be stainless steel, satin finish.

#### 2.2.13 Electric Hand Dryer (EHD)

Electric hand dryer shall be wall mounted and shall be designed to operate on 110/125 volts, 60 cycle, single phase alternating current with a heating element core rating of not more than 2100 watts. Dryer housing shall be of single piece construction and shall be white porcelain enamel.

#### 2.2.14 Utility Shelf w/Mop Strip

Utility shelf and mop strip shall be constructed of type 304 satin stainless steel. 200 mm deep by 1120 mm long with 4 mop holders and 5 utility hooks. Provide in all Janitor closets.

#### 2.2.15 Prefabricated Channel Frame Mirror

One-piece channel frame in 13 x 13 x 13 mm with bright polished finish and mitered corners. As located on the plans. Phillips-head frame screw permits easy replacement of mirror. No. 1 quality, 6 mm glass mirror electrolytically copperplated; guaranteed against silver spoilage for 10 years. Back is galvanized steel. Secured to concealed wall hanger with two theft-resistant locking screws.

#### 2.2.16 Folding Shower Seat

Seat is 13 mm thick solid phenolic provide type 304 stainless steel frame mounting bracket with self-latching mechanism. Seat size and mounting must be ADA compliant. See plans for location.

### PART 3 EXECUTION

#### 3.1 INSTALLATION

Surfaces of fastening devices exposed after installation shall have the same finish as the attached accessory. Exposed screw heads shall be oval. Install accessories at the location and height indicated. Protect exposed surfaces of accessories with strippable plastic or by other means until the installation is accepted. After acceptance of accessories, remove and dispose of strippable plastic protection. Coordinate accessory manufacturer's mounting details with other trades as their work progresses. Brackets, plates, anchoring devices and similar items used for mounting accessories in showers shall be bedded in a silicone or polysulphide sealant as they are set to provide a watertight installation. After installation, thoroughly clean exposed surfaces and restore damaged work to its original condition or replace with new work.

##### 3.1.1 Recessed Accessories

Fasten accessories with wood screws to studs, blocking or rough frame in wood construction. Set anchors in mortar in masonry construction. Fasten to metal studs or framing with sheet metal screws in metal construction.

##### 3.1.2 Surface Mounted Accessories

Mount on concealed backplates, unless specified otherwise. Accessories without backplates shall have concealed fasteners. Unless indicated or specified otherwise, install accessories with sheet metal screws or wood screws in lead-lined braided jute, teflon or neoprene sleeves, or lead expansion shields, or with toggle bolts or other approved fasteners as required by the construction. Install backplates in the same manner, or provide with lugs or anchors set in mortar, as required by the construction. Fasten accessories mounted on gypsum board and plaster walls without solid backing into the metal or wood studs or to solid wood blocking secured between wood studs, or to metal backplates secured to metal studs.

#### 3.2 CLEANING

Material shall be cleaned in accordance with manufacturer's recommendations. Alkaline or abrasive agents shall not be used. Precautions shall be taken to avoid scratching or marring of surfaces.

### 3.3 SCHEDULE

Refer to the schedule on the Drawings.

-- End of Section --



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## SECTION 11400

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## SECTION 11400

## FOOD SERVICE EQUIPMENT

**01/02**

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN CONFERENCE OF GOVERNMENTAL INDUSTRIAL HYGIENISTS (ACGIH)

ACGIH-2092M (1998) Industrial Ventilation: A manual of Recommended Practice (24th ed) (Metric)

## AMERICAN GAS ASSOCIATION LABORATORIES (AGAL)

AGAL Directory (1996) Directory of AGA and CGA Certified Appliances and Accessories

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 123/A 123M (2001) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

ASTM A 167 (1999) Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip

ASTM A 240/A 240M (2000) Heat-Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels

ASTM A 269 (2000) Seamless and Welded Austenitic Stainless Steel Tubing for General Service

ASTM B 32 (1996) Solder Metal

ASTM D 520 (2000) Zinc Dust Pigment

## AMERICAN WELDING SOCIETY (AWS)

AWS A5.8 (1992) Filler Metals for Brazing and Braze Welding

## NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 54 (1999) National Fuel Gas Code

NFPA 70 (1999) National Electrical Code

NFPA 96 (1998) Ventilation Control and Fire Protection of Commercial Cooking Equipment

## NSF INTERNATIONAL (NSF)

NSF 2 (1996) Food Equipment

NSF Product Listing (1994) Listings of Food Equipment and  
Related Products, Components, and Materials

SHEET METAL & AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION  
(SMACNA)

SMACNA HVAC Duct Const Stds (1995; Addenda Nov 1997) HVAC Duct  
Construction Standards - Metal and Flexible

## UNDERWRITERS LABORATORIES (UL)

UL 197 (1993; Rev thru Jan 2000) Commercial  
Electric Cooking Appliances

UL 471 (1995; Rev thru Apr 1998) Commercial  
Refrigerators and Freezers

UL 489 (1996; Rev thru Dec 1998) Molded-Case  
Circuit Breakers, Molded-Case Switches,  
and Circuit-Breaker Enclosures

UL 710 (1995; Rev thru Apr 1999) Exhaust Hoods  
for Commercial Cooking Equipment

## 1.2 GENERAL REQUIREMENTS

Food service equipment shall be of the sizes and types shown. Equipment, materials, and fixtures required for use in conjunction with the items to be furnished by the Government shall be furnished and installed by the Contractor. Equipment, materials, and fixtures indicated on the drawings and schedules shown as Contractor furnished and installed, shall be furnished and installed by the Contractor.

## 1.2.1 Mechanical, Electrical, and Plumbing Work

Plumbing systems, including final connections, shall be in accordance with Section 15400A PLUMBING, GENERAL PURPOSE. Electrical equipment, motors, wiring, and final connections shall be in accordance with Section 16415A ELECTRICAL WORK, INTERIOR. Gas piping and accessories, including final connections, shall be in accordance with Section 15190A GAS PIPING SYSTEMS.

Duct work and accessories shall be in accordance with Section 15895A AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEM. Painting shall be in accordance with Section 09900 PAINTS AND COATINGS. Air-conditioning systems shall be in accordance with Section 15700A UNITARY HEATING AND COOLING EQUIPMENT.

## 1.2.2 Kitchen Fire Protection Systems

Each exhaust hood system that serves cooking equipment, associated exhaust hood system ducts, and all cooking equipment served by the exhaust hood system shall be protected with a wet chemical fire extinguishing system.

### 1.2.3 National Sanitation Foundation Standards

Food service equipment shall meet the requirements set forth by the National Sanitation Foundation (NSF). Acceptable evidence of meeting the requirements of the applicable NSF standards shall be either the equipment listed in NSF Product Listing displaying the NSF seal for the year the equipment was manufactured, a certification issued for special or specific food service equipment by NSF under their special one time contract evaluation and certification, or a certified test report from an independent testing laboratory, approved by the Office of the Surgeon General, indicating that the specific food service equipment has been tested and conforms to the applicable NSF standards.

### 1.2.4 Verification of Dimensions and Coordination of Project Data

The Contractor shall become familiar with all details of the work and shall advise the Contracting Officer of any discrepancy before performing any work. The Contractor shall perform the following:

- a. Horizontal and vertical dimensions shall be field verified.
- b. Contract drawings and submittal data shall be reviewed for accuracy and completeness.
- c. The installed utility capacity and location shall be field checked.
- d. Critical systems/components shall be reviewed for application and capacities such as for exhaust hoods, refrigeration systems, fire suppression systems, gas, water, and steam/condensate line sizes and manifold configurations.
- e. Delivery shall be coordinated for access through finished openings and vertical handling limitation within the building.

### 1.2.5 Standard Products

Materials and equipment shall be the standard products of manufacturer regularly engaged in the manufacture of the products and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. The experience used shall include applications of equipment and materials under similar circumstances and of similar size. When two or more of the same products are supplied they shall be products of one manufacturer. Equipment shall be supported by a service organization that is, in the opinion of the Contracting Officer, reasonably convenient to the site.

### 1.2.6 Nameplates

Each item of equipment shall bear a stainless steel, aluminum, or engraved polyester nameplate, as standard with the manufacturer, located in a conspicuous position and permanently fastened to the equipment. Name or identification plates shall be of the size standard with the manufacturer for the particular piece of equipment provided. Name plates shall reflect the name of the manufacturer/trade name, serial number, make, and model number, pertinent ratings, operating characteristics, and other information as standard with the manufacturer, date of manufacture, electrical characteristics, and other applicable data, such as flow rate, temperature, pressure, capacity, and material of construction. Separate equipment identification plates with the contract number marked thereon, shall be

securely fastened to the surface of each piece of equipment.

#### 1.2.7 American Gas Association Laboratories Standards

Gas-burning equipment shall be designed for operation with the type of gas specified and shall be approved by AGAL. Acceptable evidence of meeting the requirements of the applicable AGAL Directory standards shall be either AGAL mark on equipment, a photostatic copy of the AGAL appliance certificate, a listing of the specific food service equipment or appliance in the AGAL Directory of Certified Appliances and Accessories, or a certified test report from a nationally recognized independent testing laboratory, indicating that the specified equipment has been tested and conforms to the requirements of the applicable AGAL standards.

#### 1.2.8 Underwriters Laboratories Standards

Electrically operated equipment shall be in accordance with applicable UL standards such as UL 471, UL 489, UL 710 and UL 197. Evidence of meeting the requirements shall be a UL label on the equipment, a UL listing mark per UL Elec Equip Dir or a certified test report from a nationally recognized independent testing laboratory indicating that the specific food service equipment has been tested and conforms to the applicable UL standards.

### 1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

#### SD-02 Shop Drawings

Food Service Equipment; G, AE.  
Installation; G, AE.

Data consisting of a complete list of equipment and materials. Detail drawings showing complete wiring, piping, and schematic diagrams, and any other details required to demonstrate that the system has been coordinated and will properly function as a unit. Drawings shall show proposed layout and anchorage of equipment and appurtenances, and equipment relationship to other parts of the work, including clearances for maintenance and operation.

a. Detail drawings by Contractor shall be separate drawings and shall be the contractor's standard sheet size, but not smaller than the contract drawings, and indicate the food service equipment and cold storage assemblies with itemized schedule, and special conditions drawings indicating size and location of slab depressions, cores, wall openings, blockouts, ceiling pockets, blocking grounds, wall, access panels, and above ceiling hanger assemblies, rough-in plumbing/mechanical systems and rough-in electrical systems.

b. Detail drawings by manufacturer shall be separate drawings; sheet size shall be manufacturer's standard size and indicate item number, name, and quantity, construction details, sections, and elevations, adjacent walls, columns, and equipment, plumbing and

electrical schematics, and fabricated fixtures with single electrical or plumbing connection, and service access panels required for maintenance or replacement of mechanical or electrical components.

c. Detail drawings by the Contractor that show the size, type, and location of equipment drain lines, and floor drains. Drawings shall indicate drain lines from equipment, distances of drain lines and floor drain receptacles from equipment and aisles, and elevation views of drain piping and floor drains.

#### SD-03 Product Data

Food Service Equipment; G, AE.

Manufacturer's descriptive and technical literature, performance charts and curves, catalog cuts, and installation instructions. Brochures shall have front and rear protective covers with labeled project name and include an index indicating item number, quantity, description, and manufacturer, a fly sheet for each component indicating item number, name, quantity, manufacturer, optional equipment, modification, special instruction, and utility requirements, and catalog specifications sheets.

#### SD-06 Test Reports

Testing.

Test reports in booklet format showing all field tests performed to prove compliance with the specified performance criteria, upon completion and testing of the installed system. Each test report shall indicate the final position of controls.

#### SD-10 Operation and Maintenance Data

Food Service Equipment.

Six complete copies of the service manual, not later than 3 months prior to the date of beneficial occupancy, with data for each different item of material and equipment specified. Service manuals shall include:

- a. Front and rear protective covers with labeled project name.
- b. Index indicating item number, quantity, description, manufacturer's name, and model number.
- c. Maintenance instructions for stainless steel and plastic laminate.
- d. Manufacturer's catalog specification sheets and manufacturer's detail and control drawings.
- e. Manufacturer's operation manual outlining the step-by-step procedures for equipment installation, startup, basic operation features, and operation shutdown.
- f. Manufacturer's maintenance manual listing routine maintenance procedures, possible breakdowns, repairs, and



troubleshooting guides. The instructions shall include simplified diagrams for the equipment as installed.

g. Manufacturer's list of parts and supplies with current unit price and address of manufacturer's parts supply warehouse.

#### 1.4 DELIVERY AND STORAGE

##### 1.4.1 Delivery

Unless otherwise directed, the following procedures shall apply:

- a. Field assembled fixed equipment integrated into structure shall be sent to jobsite when required.
- b. Fixed equipment not integrated into structure shall be sent to the jobsite after completion of finished ceilings, lighting, and acidizing of the finished floor and wall systems, including painting.
- c. Major movable equipment shall be delivered to inventory in a secured area for interim jobsite storage, or if secured area is not available, when fixed equipment installation/clean-up has been completed.
- d. Minor appliances and loose items shall be delivered to the jobsite when the Contracting Officer is prepared to receive and inventory such items.

##### 1.4.2 Storage

Items delivered and placed into storage shall be stored with protection from weather, humidity, and temperature variation, dirt and dust, or other contaminants.

##### 1.4.3 Protection of Fixed/Fabricated Manufactured Equipment

Fiberboard or plywood shall be taped to surfaces as required by equipment shape and installation access requirements.

##### 1.4.4 Prohibited Use of Equipment

Food service equipment shall not be used as tool and material storage, work bench, scaffold, or stacking area.

##### 1.4.5 Damaged Equipment

Contractor shall immediately submit documentation to the Contracting Officer with a recommendation of action for repair or replacement and the impact on project schedule.

## PART 2 PRODUCTS

### 2.1 MATERIALS

The Contractor shall comply with EPA requirements in accordance with Section 01670 RECYCLED / RECOVERED MATERIALS. Other materials shall conform to the following:

### 2.1.1 Stainless Steel, Nonmagnetic

ASTM A 167 or ASTM A 240/A 240M: 18-8, 300 Series, austenitic, polished to No. 3 or 4 finish on exposed surfaces.

### 2.1.2 Stainless Steel Pipe and Tubing

ASTM A 269. Pipe and tubing shall be seamless or welded, of the gauge specified, of true roundness, and of material as specified for stainless steel. Seamless tubing shall be thoroughly annealed, pickled, and ground smooth. Welded tubing shall be thoroughly heat-treated, quenched to eliminate carbide precipitation and then drawn true to size and roundness, and ground. Tubing shall be given a No. 3 or 4 finish when exposed to view.

### 2.1.3 Galvanizing Repair Compound

ASTM D 520, Type I pigment.

### 2.1.4 Brazing Material

AWS A5.8, class shall be as applicable.

### 2.1.5 Steel Structural Shapes for Framing

ASTM A 36/A 36M. Structural shapes shall be uniform, ductile in quality, and shall be free of hard spots, runs, checks, cracks and other surface defects. Sections shall be galvanized by the hot-dip process, conforming to ASTM A 123/A 123M.

### 2.1.6 Coatings

Coatings shall be of a durable, nontoxic, nondusting, nonflaking, and mildew-resistant type, suitable for use with food service equipment and in conformance with NSF 2. Application shall be in accordance with the recommendations of the manufacturer.

#### 2.1.6.1 Exterior Parts

Exterior, galvanized parts, exposed members of framework, and wrought steel pipe, where specified to be painted, shall be cleaned, and free of foreign matter before applying a rust inhibiting prime and two coats of epoxy-based paint in accordance with Section 09900 PAINTS AND COATINGS, unless otherwise specified. Color shall be selected by the Contracting Officer from manufacturer's standard colors.

#### 2.1.6.2 Solder Material

ASTM B 32, Sn96.

## 2.2 COUNTERS

Counters shall be constructed in accordance with applicable portions of NSF 2.

### 2.2.1 Counter Tops

Counter tops shall be constructed of 1.9 mm (14 gauge) stainless steel with all seams and corners welded, ground smooth, and polished.

### 2.2.2 Pitch and Drainage of Equipment Surfaces

Wherever a fixture has a waste or drain outlet, the surface shall have a distinct pitch toward such outlet. Corners shall be coved on 19 mm radius and sloped 10 mm per m maintaining level crown at front edges of rolled rims, marine edges, and backsplashes, when tops are sloped to drains.

### 2.2.3 Counter Edges and Backsplashes

#### 2.2.3.1 Counter Edges

Counter edges shall be one of the following types:

- a. Turned Down: Fifty millimeters at 90 degrees with 19 mm tight hem at bottom. Free Corners shall be rounded on 19 mm radius. Provide turned down edge at service and back counters of food service area.
- b. Marine Edge: Turned up 13 mm and 38 mm at 45-degree angle and turned down 50 mm at 135 degree angle with 19 mm tight hem at bottom. Provide marine edge at vegetable prep. table of food prep. area.

#### 2.2.3.2 Counter Backsplash

Counter backsplash shall be one of the following types:

- a. Coved up 250 mm and sloped back 38 mm at the top on a 45-degree angle; 63 mm slope where piping occurs. Turned down 25 mm at 135 degrees at the rear of the splash with the ends closed to the bottom of the top turn down. Splash turn down shall be secured to wall with 100 mm long, 1.9 mm (14 gauge) stainless steel "zee" clips anchored to wall, 900 mm on center. Provide this type backsplash at vegetable prep. table of food prep. area.
- b. Turned up 100 mm at 90 degrees on 16 mm radius with edge turned back 25 mm at 90-degree angle with 25 mm turn down at 90 degrees at rear of splash with the ends closed to the bottom of the top turn down. Splash turn down shall be secured to wall with 100 mm long, 1.9 mm (14 gauge) stainless steel "zee" clips anchored to wall, 900 mm on center. Provide this type backsplash at back counters of food service area.

### 2.2.4 Counter Top Support Angles

Counter top support angles shall be of 38 by 38 by 3 mm painted galvanized steel angles with all corners mitered, welded, and ground smooth at perimeter. Cross members shall be provided on 600 mm centers maximum. A 100 by 100 mm, 2.7 mm (12 gauge) stainless steel triangular pad shall be provided where leg gussets are welded to the frame. Angle frame shall be stud bolted to counter top.

### 2.2.5 Sound Deadening of Counters and Sinks

Counter tops and sinks shall be sound deadened with 13 mm wide rope sealant positioned continuously between all contact surfaces of the frame-members and the underside of counter top, overshelves and undershelves. Stud bolts shall be tightened for maximum compression and the excess sealant trimmed.

## 2.3 COUNTER BASES

Counter bases shall be open or closed as indicated.

### 2.3.1 Open Bases

Open bases shall be constructed of 41 mm outside diameter, 1.6 mm (16 gauge) stainless steel rails welded 360 degrees to the legs.

### 2.3.2 Gussets

Gussets shall be stainless steel, fully enclosed, a minimum of 75 mm in diameter at the top, reinforced with a bushing, and shall be continuously welded to channel or angle.

### 2.3.3 Legs

Legs shall be of 1.6 mm (16 gauge), 41 mm outside diameter stainless steel tubing. Legs shall be continuously welded to gussets, channel, or angle as specified.

### 2.3.4 Feet

Feet shall be sanitary, die-stamped stainless steel bullet-shaped, fully enclosed and shall provide for a 25 mm adjustment without threads being exposed. The bottom of the legs shall be finished off smoothly and the stem overlapped to provide a sanitary closed fitting. Feet for free-standing fixtures requiring utility connections shall be as above except with a flanged plate at the bottom which shall be anchored to the floor with noncorrosive bolts.

### 2.3.5 Undercounter Shelving

#### 2.3.5.1 Open Base Shelves

Open base shelves shall be constructed of 1.6 mm (16 gauge) stainless steel with all edges turned down 38 mm at 90 degrees with a 19 mm tight hem at bottom. Corners shall be notched a full 90 degrees and welded from underside to completely fill the gap, ground and polished. Undershelf shall be braced with 25 mm by 100 mm, 1.9 mm (14 gauge) stainless steel channel at longitudinal center line and between each intermediate pair of legs.

## 2.4 OVERSHELF

Overshelf shall be 1.9 mm (14 gauge) stainless steel with a 50 mm deep turn-down at free long sides with a 25 mm tight hem at inside of turn-down.

Provide a 100 mm high splash at walls on three sides of shelf. Support shelf with 50 mm x shelf depth x 10 gage triangle brackets to walls.

## 2.5 SINKS

Sink shall be of the dimensions indicated and conform to the applicable requirements of NSF 2. Sinks shall be constructed of a minimum of 1.9 mm (14 gauge) stainless steel. Vertical and horizontal corners shall be rounded to a radius of not less than 19 mm with double walls at partitions.

Continuous 1.9 mm (14 gauge) stainless steel exterior filler panels shall be provided between compartments of multiple-compartment sinks and shall be ground and polished to match the adjacent surfaces. The sink bottom shall

be scored and sloped to assure drainage to the waste outlet. Sinks shall be equipped with waste and overflow fittings, drain plugs with quick-opening valves, and faucets of the type specified. Faucet and drain plug, and overflow fitting shall be required for each sink compartment, unless otherwise indicated. Spout outlet of faucets shall be a minimum of 125 mm above the rim of the sink. Sink legs shall be as specified for counters, except that closed gussets shall be welded to the support channels. Sinks installed adjacent to walls or enclosures shall be anchored and sealed thereto. Sinks shall be sound-deadened as specified for counters.

## 2.5.1 Plumbing/Trim Requirements

### 2.5.1.1 Drain Plug and Overflow Fittings

Drain shall consist of a 38 mm quick opening brass body valve with side outlet overflow connection with a stainless steel twist lever handle. Removable perforated stainless steel strainer plate shall be not less than 75 mm in diameter. Overflow fittings shall consist of 31 mm diameter chrome-plated brass tubing of not less than 0.91 mm thickness connected to an overflow head in the back of the sink compartment. Overflow head shall have a removable perforated chrome-plated brass or stainless steel strainer plate of not less than 38 mm diameter. Overflow head shall be installed in die-stamped opening 25 mm below counter top.

### 2.5.1.2 Counter Top or Ledge-Mounted Faucets

Counter top or ledge-mounted faucets shall be combination fitting-type with a concealed body and with the supply connections under the sink ledge or counter top. The faucets shall have replaceable valve seats, swinging spout elevated to clear valve handle, and four-arm or lever-style indexed metal handles. Chrome-plated copper alloy or stainless steel escutcheons for valves and spout, locknuts and washers or lock-nut type escutcheons together with coupling nuts, and 15 mm pipe size union-tailpieces shall be provided.

### 2.5.1.3 Control Valve Mountings

Gusset-shaped 1.9 mm (14 gauge) stainless steel panel for the control valves shall be mounted on open base fixtures with 88 mm setback from the countertop edge/rim to the valve handle.

## 2.6 EXHAUST HOODS OVER COOKING EQUIPMENT

Hood shall be as described in Article 3.4.

### 2.6.1 Exhaust Duct

Exhaust duct for canopy or noncanopy hoods shall be constructed of 1.6 mm (16 gauge) black iron in accordance with SMACNA HVAC duct construction standards and shall have external seams welded continuously, liquid tight. Duct size shall be based on a minimum air velocity of 7.6 meters per second and maximum of 12.7 meters per second. Duct shall be continuously welded, liquid tight, to hood duct collar as required by NFPA 96.

### 2.6.2 Hood Support

Wall mounted hoods shall be supported from the structure with stainless steel mounting brackets provided with hoods. Hanger rods shall be 13 mm

diameter stainless steel, threaded at the bottom and designed at the top to fit into inserts in building slats above or shall have hanger attachments fastened to structural steel members. Hanger rods shall be spaced 1200 mm on center, maximum.

## 2.7 CONDENSATE HOODS

Hood and duct work systems shall conform to ACGIH-2092M, SMACNA HVAC Duct Const Stds, and NFPA 96. Unless otherwise specified, ducts and hoods shall be secured to building so as to be level and free from vibrations under all conditions of operation. Supply and installation of exhaust fans for food service equipment and exhaust hoods shall be as specified in Section 15895.

### 2.7.1 Condensate Exhaust Hood Connection Provisions

#### 2.7.1.1 Exhaust Duct for Canopy Condensate Hoods

Ducts shall be constructed of 1.3 mm (18 gauge) stainless steel. External seams shall be welded and liquid-tight. Duct size shall be based on a minimum air velocity of 4.06 meter per second. Duct shall be continuously welded, liquid tight, to hood duct collar as required by NFPA 96.

#### 2.7.1.2 Hood Support

Wall mounted hoods shall be supported from the above-ceiling structure with stainless steel mounting brackets provided with the hoods. Hanger rods shall be 13 mm diameter stainless steel, threaded at the bottom and designed at the top to fit into inserts in building slats above or hanger attachments fastened to structural steel members. Hanger rods shall be spaced 1200 mm on center, maximum.

#### 2.7.1.3 Hood Lights and Wiring

U.L. listed, recess mounted, gasketed vapor-proof fluorescent light fixtures shall be provided the full length of the hood as shown on the drawings. The light fixtures shall be prewired to junction box at a rear free corner. A Cool white T-8 energy efficient lamps shall be used.

#### 2.7.1.4 Closure Panels

Vertical corner mullions shall be provided at removable closure panels, 50 mm by 50 mm, 1.6 mm (16 gauge) stainless steel, and shall be welded integrally to furring and head channel. Exhaust hood closure panels shall be 13 mm pan-formed 1.3 mm (18 gauge) stainless steel. The upper edge of the panel shall be retained in a 25 mm by 50 mm continuous 1.6 mm (16 gauge) stainless steel head channel secured to the hood superstructure. The lower edge of the panels shall be mounted on perimeter furring cap, and shall be turned back 25 mm for "zee" clip retention.

### 2.7.2 Condensate Exhaust Hoods

Hoods, exposed ducts, and enclosures over pot washing sinks shall be constructed of 1.6 mm (16 gauge) stainless steel with seams welded, ground, and polished.

#### 2.7.2.1 Condensate Gutter

Hood shall be fabricated so as to form a condensate gutter 75 mm wide by 25 mm high at the perimeter and shall be provided with a condensate drain

terminating at a floor sink location.

#### 2.7.2.2 Duct Openings

Duct openings with collars shall be of quantity/size as indicated, with a stainless steel louvered grille at the openings. Penetrations of the dishwashing machine duct risers through the hood body shall be trimmed and sealed.

### 2.8 WATER FILTER

A cartridge-type water filter shall be provided on water supply lines to equipment as scheduled.

#### 2.8.1 Cartridge Filter

The filter shall remove dirt and off-taste items, such as chlorine and other medicined items. In addition, it shall reduce lime-scale problems when required by water conditions. The filter shall consist of a stainless steel pressure vessel, which includes shell top, bracket check valve, fittings and accessories, and plastic disposable cartridge. The cartridge shall be of the precoat filtration type in which a coating of particles is applied on a suitable fabric support. The filter shall contain not less than 90 percent activated carbon and 10 percent inert binders. The filter shall remove particles 2 microns and larger. The filter shall be installed with a three-position valve header, activation faucet, and by-pass valve which will be normally closed. In addition, an indication gauge shall be provided to indicate when cartridge requires replacement.

#### 2.8.2 Working Pressure and Flow Rate

The filter shall be installed as recommended by the manufacturer and be suitable for 860 kPa maximum working pressure at 38 degrees C water inlet temperature. Each filter shall have a flow rate of to match requirement of equipment served. An additional replacement cartridge shall be provided for each filter.

### 2.9 UTILITY DISTRIBUTION SYSTEMS

Utility distribution systems shall be UL listed and conform to NFPA 70. Systems shall be prewired and preplumbed to one final connection point. Systems shall include an electrical distribution assembly and a mechanical manifold assembly as indicated. Systems shall be provided with removable 1.6 mm (16 gauge) stainless steel panels for ease of access. Systems shall be provided with floor mounting pedestals with vertical extensions for overhead service connections.

#### 2.9.1 Electrical Distribution Assembly

The internal electrical main feeder shall be copper cable bus with the equipment ground connected to a grounding stud. Electrical assembly shall be prewired with easily removable and resettable stainless steel connection plates housing receptacle and circuit breaker. Each receptacle shall be of standard NEMA configuration and shall be positively grounded to both the receptacle connection plate and body of the enclosure. Each connection plate shall have identification plate giving voltage, amperage, phase, item number, and description of equipment connected to the receptacle. Electrical equipment shall be ground fault protected in accordance with NFPA 70. A main service disconnect shall be provided. Coded indicator

lights shall be provided to indicate the status of power to each piece of equipment. Controls shall be mounted as shown by the manufacturer.

#### 2.9.2 Mechanical Manifold Assembly

Mechanical manifold assembly shall be in accordance with Section 15400 PLUMBING, GENERAL PURPOSE and Section 15190 GAS PIPING SYSTEMS. An automatic fuel shut-off device shall be provided in the gas fuel manifold to automatically shut-off the gas supply to any piece of gas-burning equipment in the event of a fire. An automatic fuel shut-off device shall be provided for all cooking equipment served by a single exhaust hood and by adjoining exhaust hood systems. Activation of a shut-off device from one hood system or from adjoining exhaust systems shall not cause the shut down of fuel-fired equipment served by another hood system. The automatic fuel shut-off device shall be the manual-reset type only. The fuel shut-off device shall be provided with a 5 second delay to eliminate instantaneous power outages. The automatic fuel shut-off and manual fuel shut-off valves shall be mounted at the gas inputs to the utility distribution system. The fuel shut-off device shall be in conformance with NFPA 96.

#### 2.10 ELECTRICAL WORK

Electrical systems, components and accessories shall be certified to be in accordance with NFPA 70 and the following:

##### 2.10.1 Installed Equipment Load

Should the electrical load of the approved equipment differ from that specified or shown on the drawings, the contractor shall provide and install electrical service compatible with the approved equipment.

##### 2.10.2 Electrical Equipment and Components

Food service equipment furnished under this section shall have loads, voltages, and phases compatible with building system, and shall conform to manufacturer standards.

##### 2.10.3 Cords and Caps

Food service equipment cord/caps shall be coordinated with related receptacles. All 120/208 volt "plug-in" equipment shall have Type SO or SJO cord and a plug with ground, fastened to frame/body of item. Mobile equipment shall have a strain-relief assembly at the cord connection of the appliance. Mobile electrical equipment shall have cord/cap assembly with cord-hanger as provided by the manufacturer.

##### 2.10.4 Switches and Controls

Each motor-driven appliance or electrically-heated unit shall be equipped with control switch and overload protection per UL 197 and UL 471. Switches, controls, control transformers, starters, equipment protection and enclosures shall be Industry standards for the equipment environment.

##### 2.10.5 Motors

Motors at 120, 240, 208/240 and 460/480 volts shall have starter with overload protection and short circuit motor protection per manufacturer standards.



#### 2.10.6 Heating Elements

Electrically-heated equipment shall have thermostatic controls. Water heating equipment shall be equipped with a positive low-water shut-off.

#### 2.10.7 Receptacles and Switches

Receptacles which are located in vertical panels of closed base bodies shall be installed in 300 mm by 215 mm by 75 mm deep recessed mounting panel sloped on a 60-degree angle and turned up to the top of the opening. Receptacles which are located in closed base fixtures shall be prewired to a junction box located within 150 mm from the bottom of the utility compartment. Receptacles which are installed in/on fabricated equipment shall be horizontally-mounted in a metal box with a stainless steel cover plate.

#### 2.10.8 Light Fixtures

Light fixtures with lamps which are installed in/on fabricated or field-assembled equipment shall be prewired to a junction box for final connection (fixtures shall be continuous run when indicated). Fluorescent display light shall be installed the full-length of the display stand and serving shelf with stud bolts or as indicated, and shall be prewired through a support post to a recess-mounted switch. Heat lamps shall be installed to underside of serving shelf assemblies as specified. Heat lamp length for chassis shall be sized per manufacturer or as indicated on the drawings. Cold storage light fixtures shall be electrically connected through the hub fitting located on the top of the fixture. Horizontal conduit shall be above the ceiling panels. Plastic sleeves shall be installed through ceiling panels for electrical conduit and the penetrations shall be sealed airtight at both sides of panel.

#### 2.10.9 Final Electrical Connection Provisions

Final electrical connection points of equipment shall be tagged with item number, name of devices on the circuit, total electrical load, voltage, and phase. Fabricated equipment containing electrically-operated components or fittings, indicated on utility connections drawings to be direct-connected, shall have each component, fitting, or group thereof prewired to a junction box for final connection. Refer to the drawings for circuit loading. Field-assembled equipment (example, prefabricated cold storage assemblies, conveyor systems, exhaust hoods) shall have electrical components completely interconnected by this section for final connection as indicated on utility connection drawing. The following groups of cold storage assembly electrical devices shall be prewired to a top-mounted junction box for final connection per compartment grouping, unless otherwise indicated.

- a. Light fixtures, switches, and heated pressure-relief vent.
- b. Door/jamb heater and temperature monitors/alarms.
- c. Evaporator fans, defrost elements, freezer fan door switch, and drain line heaters.

#### 2.10.10 Lamps

Food service equipment containing light fixtures shall have standard appliance type bulbs or energy efficient appliance type bulbs as indicated

on the drawings. Exposed fluorescent lamps above or within a food zone shall have plastic coated T-8 energy efficient lamps or standard lamps, sleeved in plastic tube with end caps.

### PART 3 EXECUTION

#### 3.1 INSTALLATION

Equipment shall be installed at locations shown in accordance with NSF Product Listing and the manufacturer's written instructions. The Contractor shall make provision for the plumbing, heating, and electrical connections and for equipment indicated as being furnished and installed by the Government.

##### 3.1.1 Equipment Connections

Equipment connections shall be complete for all utilities. Unless otherwise specified, exposed piping shall be chromium-plated copper alloy.

##### 3.1.2 Backflow Preventers

Backflow preventers shall be furnished as specified in Section 15400 PLUMBING, GENERAL PURPOSE. The Contractor is responsible to install backflow preventers as shown on the contract drawings and at all other locations necessary to preclude a cross-connect or interconnect between a potable water supply and any source of nonpotable water, or other contaminant. Backflow preventers shall be installed at all locations where the potable water outlet is below the flood level of the equipment, or will be located below the level of the contaminant. Backflow preventers shall be provided of sufficient size to allow unrestricted flow of water to the equipment, and preclude the backflow of waste or other contamination into the potable water system.

##### 3.1.3 Gas Equipment

Installation of equipment shall conform to NFPA 54. A heavy duty steel cable, 75 mm to 150 mm shorter than the equipment connector shall be fastened to the equipment and the walls.

##### 3.1.4 Plumbing Work

Plumbing final connection points of equipment shall be tagged, indicating item number, name of devices or components, and type of utility (water, gas, drain). Extensions of indirect waste fitting shall be provided to open-sight hub drain, floor sink or floor drains from food service equipment.

#### 3.2 CONSTRUCTION OF FABRICATED EQUIPMENT

##### 3.2.1 Grinding, Polishing, and Finishing

Exposed welded joints shall be ground smooth and finished to match the adjoining material. Wherever materials have been depressed or sunken by welding operation, such depressions shall be hammered and peened flush with the adjoining surface, and again ground to eliminate high spots. Ground surfaces shall then be polished or buffed to match adjoining surfaces. Care shall be exercised in the grinding operations to avoid excessive heating of the metal and metal discoloration. Abrasives, wheels, and belts used in grinding shall be free of iron and shall not have been used on

carbon steel. In all cases, the grain of rough grinding shall be removed by several successively finer polishing operations. The texture of the final polishing operation shall be uniform, smooth, and consistent. The grain direction of horizontal stainless steel surface shall be longitudinal, including the splash back. Polishing at right angle corners shall provide a mitered appearance. Butt and contact joints shall be close fitting and not require solder as a filler. Wherever brake bends occur, the bends shall be free of open texture or orange peel appearance. Where brake work does mar the uniform appearance of the material, such marks shall be removed by grinding, polishing, and finishing. Sheared edges shall be free of burrs, projections, and fins. Where miters or bullnosed corners occur, such miters and corners shall be finished with the underage of the material and ground to a uniform condition. Overlapping of material is not acceptable. Exposed stainless steel surfaces shall have a No. 3 or 4 finish. Finishes of materials, other than stainless steel, shall be comparable in appearance to commercial mill finish. Exposed surfaces shall include:

- a. Exterior surfaces exposed to view.
- b. Interior surfaces exposed to view in doorless cabinets.
- c. Undersides of shelves shall have a ground finish of No. 90 grit or finer.

### 3.2.2 Fastening Devices

Fastening devices shall be of the same material as the metal being joined when joint pieces are of similar metal. Fastening devices shall be stainless steel when stainless steel is joined to dissimilar metal. Stud bolts shall be a minimum of M6 stainless steel with length necessary to accept washers, and required nuts, and shall be welded 225 mm on center maximum. Exposed surfaces of equipment shall be free of bolts, screws, and rivet heads. Stainless steel stud bolts shall be used to fasten tops of counters or tables to angle framing and trim to other surfaces. Such bolts shall be of the concealed type. Threads of stud bolts which are on the inside of fixtures and are either visible or might come in contact with a wiping cloth, shall be capped with chrome plated washers, lock washers, and chromium-plated brass cap nuts. Wherever bolts are welded to the underside of trim or tops, the reverse side of the welds shall be finished uniform with the adjoining surface of the trim or the top. Dimples at these points will not be acceptable.

### 3.2.3 Welding

#### 3.2.3.1 Welding Rods

Welding shall be done with welding rods of the same composition as the sheets or parts welded.

#### 3.2.3.2 Weld Quality

Welds shall be strong and ductile. Welds shall be free of imperfections such as pits, runs, spatter, cracks, low spots, voids, and shall be finished to have the same color as the adjoining surfaces. Butt welds made by welding straps under seams, or by filling in with solder, or by grinding will not be acceptable. Welded joints shall be homogeneous with the sheet metal. Spot welding shall not be substituted for continuous welding. Joints in tops of counters, tables, drainboards, exposed shelving, and

sinks shall be joined by heli-arc welding or a process other than carbon-arc welding or one that will permit carbon pick-up. Joints shall be fully welded. Counter tops shall be factory welded into lengths as long as practical in order to reduce field welded joints to a minimum. Exposed welds shall be ground smooth, flush with adjacent surface and free of burrs and sharp edges. Wherever welds occur on nonfood contact surfaces not suitable for grinding or polishing, such welds and the accompanying discoloration shall be sandblasted and coated in the factory with a nontoxic metallic-base paint. Bolts and screws shall be welded by a process that will minimize the possibility of carbide precipitation. Welds in galvanized steel made after galvanizing, and the adjacent areas where galvanizing is damaged, shall be cleaned and coated with galvanizing repair compound.

#### 3.2.4 Soldering

Soldering shall serve only as a filler to prevent leakage and shall be made with solder material. Stainless steel requiring soldering shall first be cleaned of discoloration and then have a soldering flux applied. Excess or remaining flux and catalytic material shall be removed after the soldering has been completed, and the entire soldered joint and adjacent metallic surfaces shall be cleaned with a liquid alkaline or neutralizing agent to prevent any attack on the surrounding metallic surfaces by the soldering flux.

#### 3.2.5 Brazing

Brazing shall be accomplished with brazing material. Brazing shall be used only on copper tubing to brass and bronze connection fittings.

### 3.3 TESTING

Equipment shall be inspected and tested under operating conditions after installation. If inspection or test shows defects, such defects shall be corrected, and inspection and test shall be repeated.

#### 3.3.1 Operating Tests

An operating test shall be performed on all items after complete installation and adjustment. The failed test item shall be corrected and the test shall be rerun.

#### 3.3.2 Clean and Adjust

Debris resulting from this work, as the installation progresses, shall be removed from the jobsite. All food service equipment, prior to demonstration, shall be cleaned and polished, both interior/exterior. Drawer slides and casters shall be lubricated and adjusted. Pressure regulating valves, timed-delay relays, thermostatic controls, temperature sensors, and exhaust hood grilles shall be adjusted, as required, for proper operation. Faucet aerators and line strainers shall be cleaned or replaced. Damage to painted finishes shall be touched up.

#### 3.3.3 Equipment Start-Up/Demonstration

The Contractor shall obtain the services of the manufacturer's representative experienced in the installation, adjustment and operation of the equipment specified. The representative shall supervise the start-up, adjustment, and testing of the equipment, prior to the demonstration.

Equipment shall be carefully tested, adjusted, and regulated in accordance with the manufacturer's instructions and shall be so certified in writing. A thorough operational demonstration shall be provided of all equipment and instructions furnished for general and specific care and maintenance. Selected items of equipment and attendees shall be scheduled, with the Contracting Officer, at least 2 weeks in advance of demonstration periods.

### 3.4 DESCRIPTIONS OF MANUFACTURED KITCHEN EQUIPMENT

#### 3.4.1 Reach-in Refrigerator

49-cubic foot capacity, two-section cabinet with vertically hinged, center opening doors; stainless steel cabinet exterior, front, sides, and doors; all seams closed and sealed, with metal edges turned away from exposed surface; aluminum interior cabinet liner with stainless steel floor, with internal corners coved to comply with NSF7; cabinet and doors fully insulated with pressure-injected polyurethane foam; self-closing, all-metal, fully insulated doors, with welded and polished corners, with chrome-plated, self-lubricating cam-lift hinges and chrome-plated door handles with security lock; full-perimeter, removable, magnetic vinyl gaskets; low wattage, anti-condensate, door perimeter heater; three shelves in each section adjustable on 1-inch centers on stainless steel pilasters; shelf removal and adjustment without tools or special parts; epoxy shelf finish; allowable shelf load 250-pounds, maximum cabinet load 800-pounds; top-mounted, self-contained, air-cooled refrigeration system, with hermetically-sealed compressor, thermostatic expansion valve, thermostatic temperature control, coated evaporator coil and hot gas condensate evaporator; factory installed and tested refrigeration system to maintain uniform, average 38-degree F interior temperature throughout cabinet interior; refrigeration components enclosed behind removable hatch cover; R-134A refrigerant; exterior mounted digital thermometer; attached electrical cord with ANSI 5-15P plug; master power switch; concealed switches for interior lights; 6-inch casters. Comply with NSF requirements; UL listed.

#### 3.4.2 Reach-in Freezer

49-cubic foot capacity, two-section cabinet with vertically hinged, center opening doors; stainless steel cabinet exterior, front, sides, and doors; all seams closed and sealed, with metal edges turned away from exposed surface; aluminum interior cabinet liner with stainless steel floor, with internal corners coved to comply with NSF; cabinet and doors fully insulated with pressure-injected polyurethane foam; self-closing, all-metal, fully insulated doors, with welded and polished corners, with chrome-plated, self-lubricating cam-lift hinges and chrome-plated door handles with security lock; full-perimeter, removable, magnetic vinyl gaskets; low wattage, anti-condensate, door perimeter heater; three wire shelves in each section adjustable on 1-inch centers on stainless steel pilasters; shelf removal and adjustment without tools or special parts; epoxy shelf finish; allowable shelf load 250-pounds, maximum cabinet load 800-pounds; top-mounted, self-contained, air-cooled refrigeration system, with hermetically-sealed compressor, thermostatic expansion valve, thermostatic temperature control, coated evaporator coil and hot gas condensate evaporator; factory installed and tested refrigeration system to maintain uniform, average 0-degree F interior temperature throughout cabinet; refrigeration components enclosed behind removable hatch cover; R-404A refrigerant; exterior mounted digital thermometer; attached electrical cord with ANSI 5-15P plug; master power switch; concealed switches for interior lights; 6-inch casters. Comply with NSF requirements;

UL listed.

#### 3.4.3 Soda System

Rack for ten bag-in box syrup containers, with top-mounted, air-cooled, soda-line refrigeration system designed to utilize pressurized carbon-dioxide to carbonate beverages; Provide system complete with insulated beverage lines, station fittings, connectors, water filter, water pressure regulator, high and low pressure CO2 regulators, ready to receive CO2, bag-in-boxes, and bag-in-box pumps. Finish all components with gloss enamel, or corrosion-resistant plate finish.

#### 3.4.4 Disposer

Aluminum alloy housing with polished finish; 200 mm diameter shredder and rotor with two hardened carbide alloy cutter bars; Totally enclosed, fan and water cooled motor with built-in manual reset; Tapered roller top bearing and sealed ball bottom bearing; Double Teflon seals; Single adjustable leg support; Rubber drain designed to accept 51 mm drain piping; Rubber adapter mounting; NEMA ICS6, 4x watertight controls with corrosion-resistant mounting bracket with start and stop pushbuttons, and on-off power switch, and solenoid 13 mm valve with flow control on cold water supply; Water supply line vacuum breaker and sink nozzle; Sink mounting assembly.

#### 3.4.5 Pot Wash Sink

Type 304, 14 gage polished stainless steel sinks, drain board, and front skirt of configuration indicated with three sinks and a disposer cone; Wash sink including water intake and discharge manifold that supplies nozzles that direct heated water to circulate sink; 2-horsepower circulation pump with cast iron construction with 102 mm intake and 76 mm discharge with totally enclosed fan cooled motor with permanently sealed bearings; Front mounted NEMA 4x watertight controls including on/off power switch, low/high water temperature switch, on/off pump switch, and reset switch; complete controlling labeling; 2.5 kw sanitizing booster heater with low water shutoff; sink fill faucet and pre-rinse faucet with hand-trigger valve on nozzle, mounted on flexible, sprung, stainless steel goose-neck hose; welded stainless support legs with leg braces and adjustable feet; Built-in disposer with 200 mm rotor.

#### 3.4.6 Hand Sink

Drop-in, one-compartment stainless steel sink, with 32 mm radius corners, and deck-mounted, chrome-plated, gooseneck faucet; with tail-piece and basket.

#### 3.4.7 Refrigerated Base

Stainless steel top, front, doors, and exterior ends; Flat top; All metal, welded construction, all joints and seams closed and sealed; galvanized steel exterior bottom and rear; coved aluminum interior; 95 mm swivel casters; 51 mm thickness, foamed-in-place polyurethane insulation; Doors with self-closing hinges; Removable, one piece, vinyl, self-adjusting magnetic gasket in thermal break retainer; Full-perimeter, low wattage, door frame heaters; one piece door pull; Two adjustable, epoxy coated shelves each section; Self-contained, forced-air, automatic defrost, hermetic refrigeration, air-cooled condensing unit, fin-coil evaporator, automatic, adjustable thermostat designed to maintain 3.3 C interior

temperature; R134a refrigerant, 1.8 M, NEMA 5-15 cord-plug.

#### 3.4.8 Freezer Base

Stainless steel top, front, doors, and exterior ends; Flat top; All metal, welded construction, all joints and seams closed and sealed; galvanized steel exterior bottom and rear; coved aluminum interior; 95 mm swivel casters; 51 mm thickness, foamed-in-place polyurethane insulation; Doors with self-closing hinges; Removable, one piece, vinyl, self-adjusting magnetic gasket in thermal break retainer; Full-perimeter, low wattage, door frame heaters; one piece door pull; Two adjustable, epoxy coated shelves each section; Self-contained, forced-air, automatic defrost, hermetic refrigeration, , air-cooled condensing unit, fin-coil evaporator, automatic, adjustable thermostat designed to maintain -18 C interior temperature; R404a refrigerant, 1.8 M, NEMA 5-15 cord-plug.

#### 3.4.9 Sandwich Prep Table

Stainless steel top, front, doors, and exterior ends; Flat top; All metal, welded construction, all joints and seams closed and sealed; galvanized steel exterior bottom and rear; coved aluminum interior; 95 mm swivel casters; 51 mm thickness, foamed-in-place polyurethane insulation; Doors with self-closing hinges; Removable, one piece, vinyl, self-adjusting magnetic gasket in thermal break retainer; Full-perimeter, low wattage, door frame heaters; one piece door pull; Two adjustable, epoxy coated shelves each section; Top opening fitted with 1/6 size, 102 mm deep, high-impact plastic pans; Stainless steel, telescoping, insulated cover; Top-mounted, 305 mm deep, full-width, removable/reversible, synthetic cutting board; Self-contained, forced-air, automatic defrost, hermetic refrigeration, air-cooled condensing unit, fin-coil evaporator, automatic, adjustable thermostat designed to maintain 3.3 C interior temperature; R134a refrigerant, 1.8 M, NEMA 5-15 cord-plug.

#### 3.4.10 Glass Protector

25 mm round, brushed stainless steel tubing, with glass mounting clips, and counter mounting base with 51 mm base flange, designed to support glass at an angle. Provide posts for right ends of glass protectors with glass clips on left sides of posts; provide posts for left ends of glass protectors with glass clips on right sides of posts; provide posts for center of glass protectors with glass clips on both sides of posts. Label and certify by NSF that system meets requirements for Food Shields. Provide 10 mm fully tempered glass inserts with all glass edges rounded and polished.

#### 3.4.11 Refrigerated Display

Stainless steel exterior and interior; Full-width, dual, insulating glass top and front; Stainless mirror interior; 51 mm thickness, foamed-in-place polyurethane insulation; Sliding rear doors with mirror interior finish; Removable bottom pan; Two adjustable, removable, full-width, epoxy coated shelves; Self-contained, forced-air, automatic defrost, hermetic refrigeration, air-cooled condensing unit, fin-coil evaporator, automatic, adjustable thermostat designed to maintain 3.3 C interior temperature; Refrigeration system bottom, drawer-mounted with air louvers; R134a refrigerant, 1.8 M, NEMA 5-20 cord-plug.

#### 3.4.12 Heated Soup Well

Electrically heated warming pans; Counter drop-in design with support ring

and removable insert with cover; Stainless steel construction; Control mounted in recessed, one-piece stainless front-mounted panel; Adjustable temperature with positive on/off position; Red pilot light indicating energized heating element

#### 3.4.13 Drop-in Refrigerated Pans

Stainless steel, 18 gage welded construction; Closed and sealed joints; Cross rails for three full size pans; Walls of wells insulated with 38 mm polyurethane; Front-mounted on/off switch; 1.8 M NEMA 5-15 cord-plug; Thermostatically controlled, self-contained, center, bottom mounted refrigeration system with hermetically sealed compressor and air-cooled condensing unit with high efficiency fin coils; Ventilation grille; R134a refrigeration.

#### 3.4.14 Rethermalizer

Dual 56 liter tank, heated water thermalizer; Welded type 316 stainless steel tanks; Stainless steel heat tubes; Natural gas burners with temperature limit switch; Electronic ignition; Hinged tank cover; stainless steel front, galvanized steel sides and back; Automatic water fill with in-line strainer; Bottom, 32 mm drain; Font-mounted, automatic temperature and count-down control for each tank with digital display.

#### 3.4.15 Griddle

Modular heavy-duty range with 25 mm thick polished steel griddle plate; stainless steel side splashes; front grease trough; three 30,000 BTU/hr burners with pilot ignition and manual control valves; stainless steel front with controls; epoxy finished sides; stainless steel back riser with shelf.

#### 3.4.16 Elevated Cheese Melter

Gas-fired infrared cheese melter; Stainless steel front and sides; Aluminized steel top; three overhead 6,000 BTU/hr. input burners; Gas pressure regulator; Adjustable front-mounted burner valves; Heavy-duty chrome plated rack and 3-position rack guide; Removable full width spillage pan.

#### 3.4.17 Range

Modular heavy-duty range with three 305 x 685 mm heavy duty cast iron grates; six 30,000 BTU/hr, two-piece open burners with pilot ignition and manual control valves; stainless steel front with controls; epoxy finished sides; stainless steel back riser with shelf.

#### 3.4.18 Char Broiler

Modular heavy-duty char broiler; stainless steel side splashes; front grease drawer; Heavy cast iron char radiants, and flame arrestor; 133 mm, reversible broiling grates; Grease trough, cast-into each grate blade, slopes to grease drawer; Six 14,500 BTU/hr. burners and broiler grates; Standing pilot ignition system; Under burner baffling system to reflect heat upwards; stainless steel front with controls; epoxy finished sides; stainless steel back riser with shelf.

#### 3.4.19 Refrigerated Chef's Counter



Self-contained refrigerated base to support modular cooking equipment; Six refrigerated drawers; Stainless steel front, top, sides and interior; Magnetic drawer gaskets; Fully insulated cabinet and drawers; Removable drawer liner pans; Exterior thermometer; 150 mm casters; 1.8 M cord-plug.

#### 3.4.20 Fryer with Filter Drawer

Stainless steel tube fired gas fryer; Welded steel tank with smooth, peened finish; Deep tank cool zone to hold 16-percent of oil capacity; cooking area 356 x 356 mm with 102 mm depth; Heat transfer area minimum 540,600 sq. mm; Standing pilot light; Stainless steel front, door, side, and backsplash; Automatic, adjustable thermostat; 32 mm drain valve; Removable basket hanger; 229 mm adjustable casters; Under-body, stainless steel filter drawer assembly, with 0.33 hp pump.

#### 3.4.21 Bread and Batter Station

117 mm recessed pan with removable drain screen, removable scoop pan liner, and basket hanger; Heat lamp food warmer; Design, size and finish to match fryers.

#### 3.4.22 Trough with Subway Grate

Stainless steel trough designed to fit into floor recess, receive grate, and receive floor finish; 102 mm center drain; Removable stainless steel grate to fit onto trough.

#### 3.4.23 Exhaust Hood

Wall-mounted, canopy with integral supply-air, front-discharge plenum; UL listed under Standard 710; NSF approved; Complying with NFPA-96; UL listed, self-closing, gravity operated, fusible-link fire dampers; Provide duct collars; Designed for exhaust flows based on ASTM Standard 1704; Exhaust airflow volume and static pressure at duct collar shall not exceed indicated amounts; Stainless steel, 18 gage construction on exposed surfaces; 18 gage galvanized steel construction in concealed surfaces; Double sidewall construction; All exterior joints and seams continuously welded liquid tight and ground smooth and polished; Removable, washable, multi-cyclone, stainless steel grease extractor modules; Minimum extraction efficiency of 98-percent extraction of particles 15 microns or larger, and 93-percent extraction of 5 micron particles as tested by independent laboratory; Integral test and balance ports; Integral centrifugal type fan and supply collar above canopy, with speed controller; High-velocity supply air injection jets located along hood front, interior, bottom perimeter edge to cause venturi effect to maximize air capture and minimize exhaust quantity; UL listed, recessed, pre-wired, fluorescent lighting; Concealed, accessible grease trough with removable collection receptacle for each section; Front panel with perforated face providing 10-percent free area supply ventilation; Ansul Piranha fire suppression system.

#### 3.4.24 Energy Distribution System

Wall-mounted, stainless steel enclosure for piping and wiring for all cooking equipment; Provide all required plumbing and electrical connections; Include gas and electrical shutoff activated upon hood fire detection; Provide design integrated with exhaust hood and fire protection system.

#### 3.4.25 Soda Tower, Ice Maker

Automatic load ice and beverage dispenser system with under counter ice production and ice storage, and above counter ice tower, and beverage rail; Air-cooled icemaker to produce 118 kg compressed nugget ice per day; Stainless steel dispenser tower with drain pan; Beverage rails to include eight, lever-actuated, dispensing valves; Adjustable under-bin support legs; Polyethylene lined, insulated ice storage bin; Bin openable to permit waist-level, manual ice loading; Insulated transport tubes for ice from bin to dispenser; Bin level control; Keyswitch for valves; Water filtration.

#### 3.4.26 Napkin Dispenser

Stainless steel enclosure with spring-loaded stainless steel platform; Flanged opening designed to dispense one, center-folded napkin per usage; Counter-top, drop-in design; Napkin loading from top of dispenser; Capacity 500 napkins.

#### 3.4.27 Condiment Dispenser

Under counter bag-in-box dispensing system using CO2 tank pressurization; Four flavor dispensing valves from above counter stainless steel Tee-tower.

#### 3.4.28 Under Counter Ice Cuber

Air-cooled machine producing 20 KG ice per 24-hour period at 21-degree C air temperature and 10-degree C water temperature. Produce clear ice cubes measuring 19 x 19 x 9 mm. Provide insulated, cabinet that conceals all refrigeration components and encloses top, sides and back. Provide insulated, front door with perimeter seal, with white, high gloss baked enamel steel outside finish, with one-piece, top of door pull. Provide cabinet designed for under-counter placement. Ice delivery through 11-KG capacity storage bin. Front, bottom louver-ventilated, bottom-mounted, concealed refrigeration system using R134A refrigerant. Provide drain for ice bin and shut off for water. Provide water filtration kit with replaceable filter cartridges. Provide 1.8 M, NEMA 5-15 power supply cord-plug.

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## SECTION 12705

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06/01

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## SECTION 12705

## FURNITURE SYSTEMS

**06/01**

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

## AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z97.1 (1984; R 1994) Safety Performance  
Specifications and Methods of Test for  
Safety Glazing Materials Used in Buildings

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 423 (1999a) Sound Absorption and Sound  
Absorption Coefficients by the  
Reverberation Room Method

ASTM C 1048 (1997b) Heat-Treated Flat Glass - Kind HS,  
Kind FT Coated and Uncoated Glass

ASTM E 84 (2000a) Surface Burning Characteristics of  
Building Materials

## BIFMA INTERNATIONAL (BIFMA)

BIFMA X5.5 (1989) Desk Products - Tests

BIFMA X5.6 (1993) Panel Systems - Tests

## ELECTRONIC INDUSTRIES ALLIANCE (EIA)

EIA ANSI/TIA/EIA-569-A (1998) Commercial Building Standard for  
Telecommunications Pathways and Spaces

## NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA WD 1 (1999) General Color Requirements for  
Wiring Devices

NEMA WD 6 (1997) Wiring Devices - Dimensional  
Requirements

## NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (1999) National Electrical Code

NFPA 101 (2000) Life Safety Code

NFPA 255	(2000) Method of Test of Surface Burning Characteristics of Building Materials
NFPA 265	(1998) Standard Methods of Fire Tests for Evaluating Room Fire Growth Contribution of Textile Wall Coverings

## UNDERWRITERS LABORATORIES (UL)

UL 723	(1996; Rev thru Dec 1998) Test for Surface Burning Characteristics of Building Materials
UL 1286	(1999) Office Furnishings

## 1.2 GENERAL

This specification establishes the minimum requirements for the acquisition and installation of a complete and usable system of workstations composed of panels, stacking panel-frames, spine walls, freestanding work surfaces or base units, supporting components, electrical hardware, communications, special electrical features, and accessories. Workstation requirements and configurations shall be in accordance with the furniture layout and typical workstation types shown in drawings and specified herein. Components, and hardware shall be provided by a single manufacturer and shall be a standard product as shown in the most recent published price lists or amendments. Electrical components shall be products of a single manufacturer to the extent practicable (different types of components may be of different manufacturers, but all units of a given component shall be from a single source). The completed installation shall comply with NFPA 70 and NFPA 101.

The Contractor shall coordinate the work of this section with that to be performed under other sections. This specification may include items which are not manufactured by the furniture manufacturer; any such items shall be furnished by the Contractor under this section.

## 1.3 MANUFACTURER

Notwithstanding Section 00700 Contract Clauses FAR 52.236-5, Material and Workmanship, Pre-Wired Systems furniture (or DDC.EMCS, etc) shall be manufactured by Herman Miller (or Johnson Controls Inc., etc) in order that the systems installed are fully compatible and can be integrated with existing pre-wired systems within the building (or fully compatible and fully integrated and connected to the Base Johnson Controls, INC., etc) No other product will be acceptable. The Competition Advocate authorizes sole source procurement.

## 1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Approved Detail Drawings; G, AE.  
Installation; G, AE.

Drawings showing the proposed workstation installation at a scale of 1:100 (1/4 inch = 1 foot), unless otherwise specified. Drawings showing communications, electronic data processing (EDP) and local area network (LAN) locations may be provided as a separate submittal from remaining workstation drawings. Drawing requirements, which are the furniture manufacturer's responsibility, shall be provided as a single submittal. Electronic drawings shall be provided to the user for future re-configuration in the software package requested by the user. The electronic drawings shall include all modifications made during installation.

a. Overall reference drawings: Drawings showing workstation locations and overall plan view within each floor. The scale shall be 1:200 (1/16 inch = 1 foot). Layouts shall reflect field verified conditions.

b. Installation drawings: Drawings showing workstations, panels, spine walls, components, and plan view within each floor. Workstations shall be identified by workstation type. Scale of drawings shall be identical to Architectural plans. Installation drawings shall reflect field verified conditions.

c. Workstation elevations: Dimensioned workstation elevations showing each type of workstation with panel frame and spine wall frame configurations and all components identified with manufacturer's catalog numbers. Elevations shall be drawn at 1:50 (1/2 inch = 1 foot) scale.

d. Panel drawings: Panel and Spine Wall drawings showing panel and spine wall locations and critical dimensions from finished face of walls, columns, panels, including clearances and aisle widths. Assemblies shall be keyed to a legend which shall include width, height, configuration and composition of frame covers finishes and fabrics (if different selections exist within a project), power or nonpower, connectors and wall mount hardware. Drawings shall reflect field verified conditions.

e. Electrical drawings: Drawings showing power provisions including type and location of feeder components (service entry poles, base or ceiling feeds), activated outlets and other electrical components. Wiring configuration (circuiting, switching, internal and external connections) shall be identified and a legend provided as applicable.

f. Wire management capacity drawings.

g. Communication drawings showing telephone provisions: Drawings indicating the type and location of feeder components and outlets with wiring configuration identified where applicable.

h. Communication drawings showing electronic data processing provisions: Drawings indicating the type and location of feeder components, outlets, or accessories with wiring configuration identified where applicable.

i. Communication drawings showing local area network provisions: Drawings indicating the type and location of feeder components and data outlets with extra ports for future expansion

with wiring configuration identified where applicable.

j. Reflected ceiling plan for projects specified with power poles.

#### SD-03 Product Data

Installation Instructions.

Manufacturer's product and construction specifications which provide technical data for furniture system and components specified, including task lighting and illumination performance information. Literature shall include adequate information to verify that the proposed product meets the specification.

Warranty.

Two copies of the warranty.

Workstation Components.

Complete listing of part/model numbers for all components to be furnished, including names and codes of components referenced on updated drawings.

#### SD-04 Samples

Workstations; G-AO.

Four sets of the following finish samples. The Government reserves the right to reject any finish samples that do not satisfy the construction or color requirements. The Contractor shall submit additional samples as required to obtain final approval. Work shall not proceed without sample approval in writing from the Contracting Officer.

a. Panel tackboard and flipper door fabric. Minimum 150 x 150 mm with label designating the manufacturer, color, fiber content, fabric weight, fire rating, and use (panel and/or tackboard).

b. Panel, spine wall, work surface, modesty panel, and component finish. Minimum 60 x 75 mm with label designating the manufacturer, material composition, thickness, color, and finish.

c. Task lights.

d. Panel and spine wall glazing. Glazing samples with label designating the material and safety ratings.

#### SD-07 Certificates

Workstations.

Two complete sets of certificates attesting that the proposed workstation meets specified requirements. The certificate shall be dated after the award of contract, shall name the project, and shall list specific requirements being certified.

#### SD-10 Operation and Maintenance Data



Product Assembly Manual.

Three sets of assembly manuals describing assembly and reconfiguration procedures.

Product Maintenance Manuals.  
Cleaning.

Three sets of maintenance manuals describing proper cleaning and minor repair procedures.

Electrical System.

Three sets of electrical system manuals describing the functions, configuration, and maintenance of the electrical system (power, communications, data). This material may be included in the above 2 manuals at the Contractor's option.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

Components shall be delivered to the jobsite in the manufacturer's original packaging with the brand, item identification, and project reference clearly marked thereon. Components shall be stored in a dry location that is adequately ventilated and free from dirt and dust, water, and other contaminants, and in a manner that permits easy access for inspection and handling.

#### 1.6 PATTERN AND COLOR

Pattern and color of finishes and fabrics for panels and spine walls, components, and trim shall be as shown on the drawings.

#### 1.7 ALTERNATE DESIGN

Manufacturers who are unable to provide workstations that conform exactly to the furniture layouts and typical workstation types shown in the contract drawings, may submit alternate designs for consideration by the Contracting Officer. Alternate designs must meet or exceed the following criteria. Alternate designs that are submitted but do not meet these criteria will be rejected.

##### 1.7.1 Workstation Size and Configuration

The alternate design shall provide workstations and components of the same basic size and configuration shown, with only the sizes of the individual components within the workstation changed to meet the standard product of the manufacturer.

##### 1.7.2 Component Requirements

The types of components or elements utilized shall be as shown on the drawings and as specified in PART 2 PRODUCTS of this specification.

##### 1.7.3 Layout

The storage capacity, number of workstations accommodated, width of aisles, or workstation configuration shall not be reduced.

#### 1.7.4 Wiring Configuration

Alternate configurations must support the circuiting and connection capabilities identified under the provisions pertaining to power distribution of paragraph ELECTRICAL. Generally any alternate will be acceptable which involves only a variation in size or quantity that exceeds the specified configuration.

#### 1.8 WARRANTY

The Contractor shall warrant the furniture systems for a period of 10 years with the following exceptions: fabrics and other covering materials, and paper handling products shall be guaranteed for 3 years, and task lights shall be warranted for 2 years. Electronic ballasts shall be warranted for 3 years. Warranties shall be signed by the authorized representative of the manufacturer. Warranties accompanied by document authenticating the signer as an authorized representative of the guarantor, shall be presented to the Contracting Officer upon the completion of the project. The Contractor shall guarantee that the workstation products and installation are free from any defects in material and workmanship from the date of delivery.

### PART 2 PRODUCTS

#### 2.1 PERFORMANCE AND SAFETY REQUIREMENTS

Panels, spine walls, frames and frame covers, connection system, work surfaces, pedestals, shelf units, flipper door units, lateral files, locks, accessories, and miscellaneous hardware shall meet testing as specified. ISO 9001 certified manufacturers may perform in-house testing. Manufacturers not ISO 9001 qualified shall be required to produce testing by an independent testing laboratory. Component specific requirements are listed in appropriate paragraphs.

##### 2.1.1 Selected Components

Workstations shall conform to the requirements of BIFMA X5.5 and BIFMA X5.6 with the following exceptions: Panels, spine walls and panel, or spine wall supported components shall be tested and pass in accordance with the requirements of BIFMA X5.6 and representative items shall be selected for testing based on worst case situations (i.e., the deepest and widest work surface or shelf). The keyboard drawer or shelf test shall be performed applying a 19 kg (50 lb) load to the center of the keyboard shelf for a period of 5 minutes. Any loosening of attachments, permanent deflection or damage to the operation of the drawer or shelf will be cause for rejection.

##### 2.1.2 Panel Acoustics

Acoustical panels shall have a minimum noise reduction coefficient (NRC) of 0.75 when tested in accordance with ASTM C 423. The test shall be conducted on the entire assembled panel, full face area (the complete core, adhesive, decorative fabric, frame and joining components).

##### 2.1.3 Fire Safety

Components shall meet requirements for flame spread and smoke development as specified by NFPA 101 except as follows. Testing shall have been conducted in accordance with either ASTM E 84, UL 723, or NFPA 255 on the entire assembled panel and each different combination of fabric and

interior construction. In addition, fabric shall meet the requirements of NFPA 265. Panel flame spread shall not exceed 25 for Class A and panel smoke development shall not exceed 450 for Class A.

#### 2.1.4 General Safety

Workstation products shall be free of rough or sharp edges. Panel and spine wall supported components shall have a positive, integral locking device which secures components without the use of additional screws or clamps to prevent the components from being accidentally pulled or knocked off the panels.

#### 2.1.5 Electrical System

Task lights shall be UL approved and shall meet the requirements of NFPA 70. The electrical system shall meet the requirements of UL 1286.

#### 2.1.6 Panel Glazing

Tempered glass shall conform to ASTM C 1048, Kind FT, Condition A, Type I, Class 1 Transparent and Class 3 - Light reducing, tinted or translucent.

### 2.2 PANEL SYSTEM

#### 2.2.1 Panel System

Accessories and appurtenances for a completely finished panel assembly shall be supplied complete with the system. The system shall be capable of structurally supporting cantilevered work surfaces, shelves, files, and other components in the configurations shown on the drawings. The panel system shall be capable of structurally supporting more than one fully loaded component per panel per side. Panels shall be either tackable or capable of accommodating fabric covered tackboards. The panel system shall be available in a variety of nominal widths and heights as designated on the drawings. Heights shall be measured from the finished floor to the top of the panel. Powered and nonpowered panels shall be compatible in height. Panel heights shall be coordinated with the HVAC and electrical designs.

#### 2.2.2 Finishes

a. The panels shall be available in the following options: powered, non-powered, acoustical, non-acoustical, and safety glazed,. Exposed panel trim shall have a factory baked enamel, epoxy powder finish. Filler trim shall either match the panel trim or be fabric covered to match the panel fabric. Each fabric-faced panel shall have a seamless width of fabric stretched over the entire face of the panel and the color of each fabric utilized shall be consistent throughout the installation. Curved panels may use adhesives on curved sections. The fabric shall be attached securely and continuously along the entire perimeter of the panel and shall allow for easy removal and replacement in the field (with the exception of curved panels). Fabric shall be factory installed and panel fabric content shall be 100% polyester.

#### 2.2.3 Raceways

Raceways shall be an integral part of the panel and spine wall. Panels and spine walls, whether powered or nonpowered, shall be provided with a raceway cover. Magnet held base covers will not be accepted.

#### 2.2.4 Leveling Glides

The system shall provide precise alignment of adjacent panels and spine walls and shall include leveling glides to compensate for uneven floors. On panel-to-panel products, each panel shall have 2 leveling glides. On panel-to-post products each connector shall contain a leveling glide. On stacking panel frames each vertical panel assembly shall have two leveling guides. A minimum 20 mm adjustment range is required for all systems.

#### 2.2.5 Panel and Spine Wall Connection System

The panel and spine wall system shall have connectors which accommodate a variety of configurations as shown on the drawings. A straight line connection of 2 panels (180 degrees), corner connection of 2 panels (90 degrees), T connection of 3 panels (90 degrees), cross connection of 4 panels (all 90 degrees), and a connection of 2 panels for setting the panels at any angle. The connector system shall provide tight connections with continuous visual and acoustical seals. All two-way and T connections should have plastic, painted metal, fabric or wood finish to match system. The connector system shall allow removal of a single panel or spine wall within a typical workstation configuration, without requiring disassembly of the workstation or removal of adjacent panels or spine walls. The connector system shall provide for connection of panels or spine walls of similar or dissimilar heights. Right angle (90 degree) connections between panels shall not interfere with the capability to hang work surfaces and other components on any adjacent panel. The connector system shall provide, as required, for the continuation of electrical and communications wiring within workstations and from workstation to workstation. Filler posts shall be level with the panel or spine wall top rail.

#### 2.2.6 Glazed Panels

Glazed panel inserts shall be comprised of tempered glass in accordance with ANSI Z97.1. Acrylic glazing will not be accepted.

#### 2.2.7 Door Panels

Door panels shall have a rigid metal frame with rails, a threshold, and a wood laminate or translucent panel door adaptable to either hand swing or slide to either side. Door panels shall be of a dimension that will allow for a 810 mm clear opening. Door panels shall include connectors, hinges, and brushed chrome epoxy powder baked enamel finished ADA compliant door knob.

### 2.3 TECHNOLOGY SERVICE WALL

#### 2.3.1 Product Description

The core of the modular workstation clusters shall be a service wall which serves as a spine for the office configurations. The internal structure of the service wall shall provide unlimited capacity for full lay-in cable distribution along the wall. The service wall shall make electrical and data management accessible by removable wall covers which can be removed without detaching workstation components. Data and power outlets are to be mountable at worksurface height and under the worksurface. The wall must be able to support worksurfaces, open shelves, overhead cabinets, and attached perpendicular panels. The wall shall be available in widths ranging from 1220 mm to 1830 mm. Available heights shall range from 762 mm

to 2440 mm and be available in either walls or walls with added screens. Face covers shall range from 310 mm to 1830 mm.

### 2.3.2 Interior Construction

The service wall shall be composed of steel frames and covers.

### 2.3.3 Wall Covers

Covers shall be interchangeable between full and partial height walls. The covers underneath the worksurface shall be available as a solid or a vented cover. Base raceway covers and wall covers shall be easily removable for access to power and data distribution. Service wall face covers shall be available in upholstered, tackable upholstered, outlet covers, cable tray covers and slat wall covers for paper management and accessory attachment. All covers shall be removable without the use of tools.

### 2.3.4 Leveling

Each wall section shall have leveling glides to accommodate uneven floors.

### 2.3.5 Component Connections

Overhead storage units, worksurfaces and panels must be able to connect to panels with an L, T and X configuration.

### 2.3.6 Electrical and Communications Requirements

The service wall shall have accessibility for unlimited power circuits through multiple infeeds. Power must be able to be linked to wall-attached panel system and/or adjacent desking system cable management trays. Desk height outlet modules shall mount between frame studs at any height from 530 mm to 1220 mm above or below adjacent worksurfaces. Each 310 mm wide frame shall accept two outlets housing up to two duplex outlets on each side. Outlet module covers shall have two openings for duplex outlets on each side. Outlet module covers shall have four openings for power and/or communications outlets. Hinged outlet flaps shall conceal and protect power and data outlet plugs. Unless otherwise identified with special requirements, each workstation shall have a minimum connector configuration as described in Section 16710, COMMUNICATIONS REQUIREMENTS.

#### 2.3.6.1 Wiring

Service walls shall meet the requirements of the paragraph: Wiring Configurations.

#### 2.3.6.2 Communications Wiring Management

Multi-mode fiber optic cables and Category 5 copper wiring will be installed in service wall power ways. Bending radius requirements shall be met, refer to section 16710. Separation requirements shall be 75 mm between shielded cables and 915 mm between nonshielded cables of different systems. A typical work area will require a classified telephone, unclassified LAN and another classified LAN with each needing to maintain separation defined in security. Power and communications shall be separated. Cable clips, approximately 50 per wall frame, shall support and manage cables on the face of the wall frame studs. Each clip shall manage up to 12 CAT5 cables. High capacity cable holders shall be available to hold approximately 20 per wall frame and support and manage

larger bundles of cables. Each shall hold up to 40 CAT5 cables. Two holders shall attach to studs at each 230 mm level. The service wall capacity for 4 pair CAT5 wires shall be approximately 1000. Service wall must be able to accept Category 5 fiber optic data outlets in the base or at desk height. Final electrical and data locations are to be determined after initial installation plans are determined. Raceways shall be able to accommodate capacity for a combined run of up to eight workstations minimum. Raceways shall be able to accommodate the bend radius of the FO and UTP cable.

## 2.4 WORK SURFACES

Worksurfaces shall be constructed to prevent warpage. Worksurfaces shall be freestanding. Worksurfaces adjacent to panels shall have cable management trays. Abutting worksurfaces shall mate closely and be at equal heights when used in side-by-side configurations in order to provide a continuous and level worksurface. Worksurfaces shall be provided in sizes and configurations shown on the drawings. Worksurfaces shall be available in nominal depths of 510 mm 610 mm and 760 mm plus or minus 50 mm, nominal lengths from 610 to 1830 mm), and a nominal thickness from 25 mm to 45 mm. Worksurfaces abutting at equal heights shall provide a continuous and level worksurface. Corner worksurfaces, peninsula worksurfaces, and counter/transaction worksurfaces shall be provided as shown on the drawings and shall include hardware necessary to provide firm and rigid support.

### 2.4.1 Finishes

The work surfaces shall have a finished top surface of high pressure plastic laminate and shall have a smoothly finished underside. The work surface shall not be affected by ordinary household solvents, acids, alcohols, or salt solutions, and shall be capable of being cleaned with ordinary household cleaning solutions. Metal support brackets shall match the color and finish of trim. Edges shall be post formed or vinyl molding.

## 2.5 PEDESTALS

Drawer configurations and pedestal height shall be as shown on the drawings. The pedestal shall be provided for each work surface.

### 2.5.1 Construction

With the exception of drawer fronts, pedestals and drawers shall be of steel construction. Drawer faces shall be securely attached to the drawer front. Pedestals shall be freestanding on casters.

### 2.5.2 Finishes

The finish of steel surfaces shall be a factory baked enamel finish or powder coated. Drawer fronts shall be either steel or molded plastic.

### 2.5.3 Drawer Requirements

Pedestals shall be field interchangeable from left to right, and right to left, and shall retain the pedestal locking system capability. Pedestals shall be designed to protect wires from being damaged by drawer operation. Pedestals shall be work surface hung, or shall support work surfaces, or shall be free standing; as shown. Drawers shall stay securely closed when in the closed position and each drawer shall contain a safety catch to prevent accidental removal when fully open. File drawers shall have either

a cradle type or full extension ball bearing suspension with hanging folder frames or compressor dividers. File drawers shall be 305 mm high. Box drawers shall be provided with pencil trays and stationary trays. Center pencil drawer shall be mounted under the work surface.

## 2.6 VERTICAL STORAGE CABINETS

Vertical storage cabinets shall accommodate video monitors, binders, media, wardrobe and file storage. Storage cabinets must be available in 1220 mm and 1625 mm high, 610 mm wide, and 610 mm and 760 mm deep. Shelves shall have the enclosure option of hinged doors. Cabinets shall have in the bottom of the area above the files (where files are furnished) to allow cables to pass through to the floor. Finishes must be compatible with the other furniture systems.

## 2.7 PANEL SUPPORTED STORAGE

Flipper door cabinets, and shelf units shall be provided in the sizes and configurations shown on the drawings. Flipper door and shelf unit cabinets shall accommodate task lighting and shall have a depth to accommodate a standard three ring binder.

### 2.7.1 Shelf Unit Construction

The shelf pan shall be of metal construction with formed edges. Shelf supporting end panels shall be constructed of metal, high density particle board, molded phenolic resin, or molded melamine. Shelf units shall accommodate relocatable shelf dividers.

### 2.7.2 Flipper Door Unit Construction

Flipper door unit shall be of equal construction to shelf units. Flipper doors shall be constructed of metal with formed edges. Units shall remain securely fastened to the panel when in the locked position. Doors shall utilize a suspension system. The door shall be available to slide over the top of the bin.

### 2.7.3 Lateral File Unit Construction

Lateral files shall be of steel construction. File fronts, top and end panels shall be of equal construction to shelf units. File drawers shall have full extension ball bearing drawer slides or rack and pinion suspension. File drawers shall have hanging folder frames, compressor dividers or rails and shall be capable of hanging side-to-side or front-to-back.

### 2.7.4 Finish

Shelves and dividers and top dust cover shall have a factory baked enamel finish. Shelf supporting end panels shall have either a factory baked enamel or laminate finish. Shelf bottom shall match end panel color. Metal doors shall have an exterior finish of factory baked enamel or a factory installed fabric covering and an interior finish of factory baked enamel. Metal drawers shall have a factory baked enamel finish.

## 2.8 ACCESSORIES

### 2.8.1 Coat Storage

One coat hook per workstation .

#### 2.8.2 Keyboard Tray

Work surfaces shall be capable of accepting an articulating keyboard on workstations as shown on the drawings. The keyboard tray shall have the capability to be fully recessed under the work surface and extend to give the user full access to the keyboard. Side travel rotation shall be a 180-degree swing. The keyboard tray shall have tilting capability and shall contain a wrist support. It should also include a mouse pad at the same level as the keyboard, and accommodate either right or left-handed users.

#### 2.8.3 Erasable Marker Boards

Marker boards shall have a white writing surface which can be easily written on and erased and shall be unaffected by common marker board cleaning/conditioning agents and shall contain a storage tray.

#### 2.9 MISCELLANEOUS HARDWARE

Brackets, supports, hangers, clips, panel supported legs, connectors, adjustable feet, cover plates, stabilizers, and other miscellaneous hardware shall be provided.

#### 2.10 LOCKS AND KEYING

Drawers, flipper door cabinets, and lateral files shall have keyed locks, unless otherwise noted. Field changeable lock cylinders shall be provided with different key options for each person. Each workstation shall be individually keyed. Drawers within a pedestal shall be lockable either by a central lock that controls all pedestals under one work surface or an individual keyed lock in each pedestal. Central file and storage units which are grouped together but are not a part of a workstation shall be keyed alike unless otherwise specified. Door panels shall have keyed lock set. Two keys shall be provided for each lock or 2 keys per workstation when keyed alike, and 3 master keys shall be provided per area as shown on the contract drawings. Keys and lock cylinders shall be numbered for ease of replacement. Locks shall be clearly labeled with a key number, except for those manufacturers who have removal format locks.

#### 2.11 ELECTRICAL

##### 2.11.1 Wiring Configurations

Panels and service walls shall be capable of supporting all of the following configurations (and field conversion of any one of the configurations):

- a. Three 20 amp circuits utilizing a common neutral and system ground, and a fourth dedicated 20 amp circuit utilizing separate line, neutral, and grounding conductors.
- b. Two 20-amp circuits utilizing a common neutral and system ground, and two 20-amp isolated ground circuits using the second neutral and isolated ground conductor.
- c. One 20 amp circuit utilizing a neutral and system ground, and three 15-amp isolated ground circuits utilizing the second neutral and



isolated ground conductor.

#### 2.11.2 Panel Systems

Both powered and nonpowered panels shall have under worksurface raceways capable of distributing power circuits and communication cables. Nonpowered panel raceways shall be capable of easy field conversion to powered panel base without requiring the panel to be dismantled or removed from the workstation. The system shall use copper cable assemblies, wiring harnesses or electrified bus and shall meet requirements of UL 1286 and NFPA 70, Article 605. Conductors shall consist of 90 degree C, #10 AWG Neutral or #12 AWG copper wires or the equivalent in a copper bus configuration. Dedicated #12 AWG neutrals (one neutral per phase conductor) may be provided in lieu of a share #10 AWG neutral. The label or listing of Underwriter's Laboratories, Inc. will be accepted as evidence that the material or equipment conforms to the applicable standards of that agency. In lieu of this label or listing, a statement from a nationally recognized, adequately equipped testing agency shall be submitted indicating that the items have been tested in accordance with required procedures of UL and that the materials and equipment comply with contract requirements. Electrical work not addressed in this section shall conform to the requirements of Section 16415 ELECTRICAL WORK, INTERIOR.

#### 2.11.3 Panel Raceways

Panels shall have hinged or removable covers that permit easy access to the raceway when required but are securely mounted and cannot be accidentally dislodged under normal conditions. The raceway shall not extend past either panel face by more than 10 mm. Metal or plastic covers which attach securely to the raceway shall be provided as required and shall match the finish and color of the panel trim. Raceways in full size over 610 mm powered panels shall have a minimum of 2 knockouts (doors) per side for electrical connections or outlets as indicated elsewhere.

##### 2.11.3.1 Powered Panels

Powered panels shall be provided. The panels shall have an internal power and communications raceway and the capability of disconnecting and connecting external circuits to the electrified raceway in the panel. The communications receiving raceway shall have capacity for at least eight 4-pair Category 5 cables and thirty two 2-pair fiber optic cables. Power and communications wiring may share a common wireway if a metal divider is included to ensure electrical isolation. Doors or access openings shall be included for entry of communications cable. The electrified power raceway shall support the configurations listed in paragraph, WIRING CONFIGURATIONS.

##### 2.11.3.2 Receptacles

Power receptacles shall be provided in service wall outlet modules unless shown otherwise. Devices shall be connected to the designated circuits. Unless otherwise indicated, receptacles shall be 15 amp (NEMA 5-15R) commercial grade conforming to NEMA WD 1 and NEMA WD 6. If receptacles are not interchangeable or will not permit field adjustment of phase and circuit selection. All General use receptacles shall be of the duplex configuration; unless otherwise indicated. The color of receptacle bodies shall be coordinated with the color of the panel trim. Isolated ground and surge suppressor receptacles shall have distinct markings or be of a different color than other receptacles as indicated in Section 01007, ELECTRICAL REQUIREMENTS. Field applied identification shall be permanent;

stick-on or non-setting adhesives shall not be used.

## 2.12 ELECTRICAL

### 2.12.1 Electrical Connections

#### 2.12.1.1 Internal Connections

Internal panel-to-panel power connections shall utilize straight or flexible plug/receptacle connector assemblies.

#### 2.12.1.2 Connections to Building Services

Wiring from building services shall be extended to the entry modules or panel raceways in liquidtight flexible metal conduit, 1830 mm maximum length. Provide separate connections for power. Connections shall be concealed behind panels or service walls. Cord and plug assemblies shall not be used for any portion of external links. Base feed modules shall plug into the end or either side of the raceway at receptacle doors. Top entry modules junction box assemblies shall extend the power and communications wiring into service entry poles attached to the electrified panels. External wiring shall conform to Section 16415 ELECTRICAL WORK, INTERIOR.

#### 2.12.2 Wire Management

Wire management capability shall be provided at all workstations. Actual wire management capacity shall accommodate all cable types specified, including the applicable manufacturer required bending radius at corners. Raceways and interfaces to the raceways shall be designed to accommodate the bend radius as shown in EIA ANSI/TIA/EIA-569-A for Category 5 communication wiring and for fiber optic cabling. The capability may be accomplished by cable access cutouts (1 minimum per work surface), covered wire management troughs in vertical end panels, horizontal wiring troughs, internal midpanel (beltline) raceways, or rear gaps (between the back edge of the work surface and the facing support panel). Grommet kits or another suitable finish arrangement shall be provided for all cable cutouts. Accessories for an externally mounted vertical and horizontal wire management and concealment system shall be provided as indicated on the contract drawings. The wire managers shall be attached either to the underside of the work surface or to the vertical panel without damaging the face. Exposed or loose wiring will not be acceptable. Wire managers shall be prefinished and shall secure, conceal, and accommodate outlet cords as well as electrical and communications wiring. Wire channels shall match color of panel trim, attach by means of clip-on attachment, and shall conceal wires routed vertically. Power wiring shall be separated from communication wiring by use of separate raceways or by placement of channels in joint use troughs or wireways.

#### 2.12.3 Circuit Layout

Devices shall be connected to the designated circuits in the neutral and ground configurations indicated. Connections shall be made to the building electrical distribution system as shown on the contract drawings and in accordance with Section 16415 ELECTRICAL WORK, INTERIOR.

#### 2.12.4 Task Lighting

Task light size and placement shall be provided as indicated on the

contract drawings. Such lights shall be a standard component of the manufacturer's workstation products. The ends of the task light length shall not extend beyond the edges of the overhead unit. Task lights shall have structurally sound mounting devices which will prevent accidental displacement, but will allow easy removal and replacement when necessary. Fixtures shall be UL approved for use in the configurations indicated on the drawings.

#### 2.12.4.1 Luminaire Configuration

Luminaires shall be the fluorescent type and shall have prismatic lenses, baffles, or reflector systems configured to minimize glare by shielding the lamp from the view of a seated user. Task lights for each workstation shall provide a minimum of 650 lx of light (horizontally measured), without veiling reflections, on the work surface directly below and a maximum of 500 mm from the fixture. All diffusers, grilles or other coverings shall be easily removable to permit cleaning and relamping. Fixtures shall be provided with energy efficient ballasts and lamps as indicated. Provide T8 lamps with electronic ballasts. Each luminaire shall have an easily accessible on-off switch and one rapid-start ballast. A variable intensity control is acceptable if the low setting is equivalent to "off" with zero energy consumption. Multiple switching is also acceptable. Ganged fixtures or shared ballasts shall not be used. Lamps and ballasts shall conform to the requirements of Section 16415 ELECTRICAL WORK, INTERIOR.

#### 2.12.4.2 Wiring

Each fixture shall have a 1830 mm minimum, factory installed, heavy duty electrical cordset with a grounded plug. Direct or hard wire connections are not acceptable. Unless otherwise indicated, cords shall be concealed. Cord concealment shall be built-in within spine walls or shall utilize field installed, manufacturer approved accessories. Cords may be extended through dedicated channels located at any point within panels or may be placed in vertical slots or in the space between panels and spine walls if held in place by retainers and concealed by a cover plate. Vertical wire managers shall be prefinished and cut to size and shall extend from the task light level down to the top of the work surface below the task light. Each manager shall be attached to a panel vertical edge or connector strip without damage to the surfaces.

#### 2.12.5 Communications

Communications wiring shall be extended to, and installed in, the panels and service walls in liquid-tight flexible metal conduit. Connections shall be concealed behind panels or service walls. Communications outlets shall be installed as required in Section 16710, COMMUNICATIONS REQUIREMENTS. Communications work may be performed in conjunction with the installation of the prewired workstations or may be separately executed at the Contractor's option; however, equipment, materials, and installation shall conform to the requirements of Section 16415, ELECTRICAL WORK, INTERIOR; Section 16710, PREMISES DISTRIBUTION SYSTEM; Section 16710, COMMUNICATIONS REQUIREMENTS and all interfaces must be properly coordinated. The panel furniture system must provide for terminal mounting blocks, Category 5 patch panels and industry standard routing and switching components to be mounted inside each panel frame unit in compliance with ANSI/TIA/EIA TSB-75 solutions. Power wiring shall not run in the same raceway as communication cabling. Maintain 1M separation between red and black communication cabling.

### 2.12.6 Special Systems

Designated raceway systems shall provide management for secure and nonsecure power, computer and telecommunications cabling. Secure distribution shall be separated from nonsecure distribution in accordance with details shown on the plans by running secure lines along top located raceway and nonsecure along the bottom of the workstation panel .

## PART 3 EXECUTION

### 3.1 INSTALLATION

The workstations shall be installed by certified installers in accordance with manufacturer's recommended installation instructions. Workstation components shall be installed level, plumb, square, and with proper alignment with adjoining furniture. The components shall be securely interconnected and securely attached to the building where required. Three sets of special tools and equipment necessary for the relocation of panels and other components shall be furnished.

### 3.2 CLEANING

Upon completion of installation, all products shall be cleaned and polished and the area shall be left in a clean and neat condition. Any defects in material and installation shall be repaired, and damaged products that cannot be satisfactorily repaired shall be replaced.

-- End of Section --

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## SECTION 13080

## SEISMIC PROTECTION FOR MISCELLANEOUS EQUIPMENT

**04/99**

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## SECTION 13080

## SEISMIC PROTECTION FOR MISCELLANEOUS EQUIPMENT

**04/99**

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 36/A 36M	(1997a) Carbon Structural Steel
ASTM A 53	(1999) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 153/A 153M	(1998) Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 307	(1997) Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength
ASTM A 325M	(1997) High-Strength Bolts for Structural Steel Joints (Metric)
ASTM A 500	(1999) Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A 563	(1997) Carbon and Alloy Steel Nuts
ASTM A 572/A 572M	(1999) High-Strength Low-Alloy Columbium-Vanadium Structural Steel
ASTM A 603	(1998) Zinc-Coated Steel Structural Wire Rope
ASTM A 653/A 653M	(1999) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM E 488	(1996) Strength of Anchors in Concrete and Masonry Elements

## ASME INTERNATIONAL (ASME)

ASME B18.2.1	(1996) Square and Hex Bolts and Screws (Inch Series)
ASME B18.2.2	(1987; R 1999) Square and Hex Nuts (Inch Series)

## U.S. ARMY CORPS OF ENGINEERS (USACE)

TI 809-04

(1998) Seismic Design for Buildings

## 1.2 SYSTEM DESCRIPTION

## 1.2.1 General Requirements

The requirements for seismic protection measures described in this section shall be applied to the mechanical equipment and systems outlined in Section 15070 SEISMIC PROTECTION FOR MECHANICAL EQUIPMENT, the electrical equipment and systems outlined in Section 16070 SEISMIC PROTECTION FOR ELECTRICAL EQUIPMENT, and the miscellaneous equipment and systems listed below. Seismic protection requirements shall be in accordance with TI 809-04 and additional data furnished by the Contracting Officer, and shall be provided in addition to any other requirements called for in other sections of these specifications. The design for seismic protection shall be based on a Seismic Use Group I for HQ Beddown and IIIE for C.O.C. building occupancy and on site response coefficients for  $S_{MS} = 0.2$  and  $S_{M1} = 0.1$ . Resistance to lateral forces induced by earthquakes shall be accomplished without consideration of friction resulting from gravity loads. The basic force formulas, for Ground Motions A and B in Chapter 3 of TI 809-04, use the design spectral response acceleration parameters for the performance objective of the building, not for equipment in the building; therefore, corresponding adjustments to the formulas shall be required.

## 1.2.2 Miscellaneous Equipment and Systems

The bracing for the following miscellaneous equipment and systems shall be developed by the Contractor in accordance with the requirements of this specification:

Storage cabinets  
Storage Racks  
Shelving  
Partitions

Ornamentations  
Signs and Billboards  
Furnishings

## 1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

## SD-02 Shop Drawings

Bracing.  
Resilient Vibration Isolation Devices.  
Equipment Requirements.

Detail drawings along with catalog cuts, templates, and erection and installation details, as appropriate, for the items listed. Submittals shall be complete in detail; shall indicate thickness, type, grade, class of metal, and dimensions; and shall show construction details, reinforcement, anchorage, and installation with relation to the building construction. For equipment and systems in buildings that have a performance objective higher than

life-safety, the drawings shall be stamped by the registered engineer who stamps the calculations required above.

#### SD-03 Product Data

Bracing; G, AE.

Equipment Requirements; G, AE.

Copies of the design calculations with the detail drawings. Calculations shall be stamped by a registered engineer and shall verify the capability of structural members to which bracing is attached for carrying the load from the brace.

### 1.4 EQUIPMENT REQUIREMENTS

#### 1.4.1 Rigidly Mounted Equipment

Rigidly mounted equipment furnished under this contract shall be constructed and assembled to withstand the seismic forces specified in TI 809-04, Chapter 10. For any rigid equipment which is rigidly attached on both sides of a building expansion joint, flexible joints for piping, electrical conduit, etc., that are capable of accommodating displacements equal to the full width of the joint in both orthogonal directions, shall be provided.

#### 1.4.2 Nonrigid or Flexibly-Mounted Equipment

Non rigid or flexibly-mounted equipment shall be constructed and assembled to resist a horizontal lateral force of 0.48 times the operating weight of the equipment at the vertical center of gravity of the equipment servicing the C.O.C. The coefficient equals 0.32 for equipment servicing the HQ Beddown.

## PART 2 PRODUCTS

### 2.1 BOLTS AND NUTS

Squarehead and hexhead bolts, and heavy hexagon nuts, ASME B18.2.1, ASME B18.2.2, or ASTM A 307 for bolts and ASTM A 563 for nuts or ASTM A 325M for bolts and nuts. Bolts and nuts used underground and/or exposed to weather shall be galvanized in accordance with ASTM A 153/A 153M.

### 2.2 SWAY BRACING

Material used for members listed in this section and on the drawings, shall be structural steel conforming with the following:

- a. Plates, rods, and rolled shapes, ASTM A 36/A 36M or ASTM A 572/A 572M, Grade 503. If the Contractor does the design, both ASTM A 36/A 36M and ASTM A 572/A 572M, grade 503 will be allowed.
- b. Wire rope, ASTM A 603.
- c. Tubes, ASTM A 500, Grade B.
- d. Pipes, ASTM A 53, Type E or S, Grade B.
- e. Light gauge angles, less than 6 mm thickness, ASTM A 653/A 653M .



## PART 3 EXECUTION

## 3.1 BRACING

Bracing shall conform to the arrangements shown. Trapeze-type hanger shall be secured with not less than two 13 mm bolts.

## 3.2 BUILDING DRIFT

Sway braces for a piping run shall not be attached to two dissimilar structural elements of a building that may respond differentially during an earthquake unless a flexible joint is provided.

## 3.3 ANCHOR BOLTS

## 3.3.1 Cast-In-Place

Floor or pad mounted equipment shall use cast-in-place anchor bolts, except as specified below. One nut shall be provided on each bolt. Anchor bolts shall conform to ASTM A 307. Anchor bolts shall have an embedded straight length equal to at least 12 times nominal diameter of the bolt. Anchor bolts that exceed the normal depth of equipment foundation piers or pads shall either extend into concrete floor or the foundation shall be increased in depth to accommodate bolt lengths.

## 3.3.2 Expansion or Chemically Bonded Anchors

Expansion or chemically bonded anchors shall not be used unless test data in accordance with ASTM E 488 has been provided to verify the adequacy of the specific anchor and application. Expansion or chemically bonded anchors shall not be used to resist pull-out in overhead and wall installations if the adhesive is manufactured with temperature sensitive epoxies and the location is accessible to a building fire. Expansion and chemically bonded anchors shall be installed in accordance with the manufacturer's recommendations. The allowable forces shall be adjusted for the spacing between anchor bolts and the distance between the anchor bolt and the nearest edge, as specified by the manufacturer.

## 3.3.2.1 General Testing

Expansion and chemically bonded anchors shall be tested in place after installation. The tests shall occur not more than 24 hours after installation of the anchor and shall be conducted by an independent testing agency; testing shall be performed on random anchor bolts as described below.

## 3.3.2.2 Torque Wrench Testing

Torque wrench testing shall be done on not less than 50 percent of the total installed expansion anchors and at least one anchor for every piece of equipment containing more than two anchors. The test torque shall equal the minimum required installation torque as required by the bolt manufacturer. Torque wrenches shall be calibrated at the beginning of each day the torque tests are performed. Torque wrenches shall be recalibrated for each bolt diameter whenever tests are run on bolts of various diameters. The applied torque shall be between 20 and 100 percent of wrench capacity. The test torque shall be reached within one half turn of the nut, except for 9 mm sleeve anchors which shall reach their torque by one quarter turn of the nut. If any anchor fails the test, similar anchors

not previously tested shall be tested until 20 consecutive anchors pass. Failed anchors shall be retightened and retested to the specified torque; if the anchor still fails the test it shall be replaced.

#### 3.3.2.3 Pullout Testing

Expansion and chemically bonded anchors shall be tested by applying a pullout load using a hydraulic ram attached to the anchor bolt. At least 5 percent of the anchors, but not less than 3 per day shall be tested. The load shall be applied to the anchor without removing the nut; when that is not possible, the nut shall be removed and a threaded coupler shall be installed of the same tightness as the original nut. The test setup shall be checked to verify that the anchor is not restrained from withdrawing by the baseplate, the test fixture, or any other fixtures. The support for the testing apparatus shall be at least 1.5 times the embedment length away from the bolt being tested. Each tested anchor shall be loaded to 1 times the design tension value for the anchor. The anchor shall have no observable movement at the test load. If any anchor fails the test, similar anchors not previously tested shall be tested until 20 consecutive anchors pass. Failed anchors shall be retightened and retested to the specified load; if the anchor still fails the test it shall be replaced.

#### 3.4 RESILIENT VIBRATION ISOLATION DEVICES

Where the need for these devices is determined, based on the magnitude of the design seismic forces, selection of anchor bolts for vibration isolation devices and/or snubbers for equipment base and foundations shall follow the same procedure as in paragraph ANCHOR BOLTS, except that an equipment weight equal to five times the actual equipment weight shall be used.

##### 3.4.1 Resilient and Spring-Type Vibration Devices

Vibration isolation devices shall be selected so that the maximum movement of equipment from the static deflection point shall be 13 mm.

##### 3.4.2 Multidirectional Seismic Snubbers

Multidirectional seismic snubbers employing elastomeric pads shall be installed on floor- or slab-mounted equipment. These snubbers shall provide 6 mm free vertical and horizontal movement from the static deflection point. Snubber medium shall consist of multiple pads of cotton duct and neoprene or other suitable materials arranged around a flanged steel trunnion so both horizontal and vertical forces are resisted by the snubber medium.

#### 3.5 SWAY BRACES FOR PIPING

Transverse sway bracing for steel and copper pipe shall be provided at intervals not to exceed those shown on the drawings. Transverse sway bracing for pipes of materials other than steel and copper shall be provided at intervals not to exceed the hanger spacing as specified in Section 15400 PLUMBING, GENERAL PURPOSE. Bracing shall consist of at least one vertical angle 50 x 50 mm x 16 gauge and one diagonal angle of the same size.

##### 3.5.1 Longitudinal Sway Bracing

Longitudinal sway bracing shall be provided in accordance with Section 15070

## SEISMIC CONTROL FOR MECHANICAL EQUIPMENT.

## 3.5.2 Anchor Rods, Angles, and Bars

Anchor rods, angles, and bars shall be bolted to either pipe clamps or pipe flanges at one end and cast-in-place concrete or masonry insert or clip angles bolted to the steel structure on the other end. Rods shall be solid metal or pipe as specified below. Anchor rods, angles, and bars shall not exceed lengths given in the tabulation below.

## 3.5.3 Maximum Length for Anchor Braces

Type	Size (millimeters)	Maximum Length* (meters)
Angles	38 x 38 x 6	1.5
	50 x 50 x 6	2.0
	64 x 38 x 6	2.5
	75 x 64 x 6	2.5
	75 x 75 x 6	3.0
Rods	91	1.0
	22	1.0
Flat Bars	38 x 6	0.4
	50 x 6	0.4
	50 x 10	0.5
Pipes (40s)	25	2.0
	32	2.8
	40	3.2
	50	4.0

## 3.5.4 Bolts

Bolts used for attachment of anchors to pipe and structure shall be not less than 13 mm diameter.

## 3.6 EQUIPMENT SWAY BRACING

## 3.6.1 Suspended Equipment and Light Fixtures

Equipment sway bracing shall be provided for items supported from overhead floor or roof structural systems, including light fixtures. Braces shall consist of angles, rods, wire rope, bars, or pipes arranged as shown and secured at both ends with not less than 13 mm bolts. Sufficient braces shall be provided for equipment to resist a horizontal force equal to two times the weight of equipment without exceeding safe working stress of bracing components. Details of equipment bracing shall be submitted for acceptance. In lieu of bracing with vertical supports, these items may be supported with hangers inclined at 45 degrees directed up and radially away from equipment and oriented symmetrically in 90-degree intervals on the horizontal plane, bisecting the angles of each corner of the equipment, provided that supporting members are properly sized to support operating weight of equipment when hangers are inclined at a 45-degree angle.

## 3.6.2 Floor or Pad Mounted Equipment

#### 3.6.2.1 Shear Resistance

Floor mounted equipment shall be bolted to the floor. Requirements for the number and installation of bolts to resist shear forces shall be in accordance with paragraph ANCHOR BOLTS.

#### 3.6.2.2 Overturning Resistance

The ratio of the overturning moment from seismic forces to the resisting moment due to gravity loads shall be used to determine if overturning forces need to be considered in the sizing of anchor bolts. Calculations shall be provided to verify the adequacy of the anchor bolts for combined shear and overturning.

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SECTION 13100

LIGHTNING PROTECTION SYSTEM

07/01

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## SECTION 13100

LIGHTNING PROTECTION SYSTEM  
07/01

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (1999) National Electrical Code

NFPA 780 (1997) Installation of Lightning Protection Systems

## UNDERWRITERS LABORATORIES (UL)

UL 96 (1994; Rev thru Jan 2000) Lightning Protection Components

UL 96A (1994; Rev thr Jul 1998) Installation Requirements for Lightning Protection Systems

UL 467 (1993; Rev thru Apr 1999) Grounding and Bonding Equipment

UL Elec Const Dir (1999) Electrical Construction EquipmentDirectory

## 1.2 GENERAL REQUIREMENTS

## 1.2.1 Services of Lightning Protection Engineer

The Contractor shall obtain the services of a Lightning Protection Engineer to design, supervise, and to inspect the installation of the lightning protection system. Lightning Protection Engineer refers to a person, who, by reason of his knowledge of the physical sciences and the principles of engineering and mathematics, acquired by professional education and related practical experience, is qualified to engage in the practice of lightning protection of public buildings and structures. Such person may be a licensed professional engineer or may be a person certified as being qualified by the Lightning Protection Institute if such licensing or certification includes suitable experience in lightning protection. The Lightning Protection Engineer shall insure that the lightning protection system is designed, installed, tested, and placed into service in accordance with the requirements specified.

## 1.2.2 Verification of Dimensions

The Contractor shall become familiar with all details of the work, verify

all dimensions in the field, and shall advise the Contracting Officer of any discrepancy before performing the work. No departures shall be made without the prior approval of the Contracting Officer.

### 1.2.3 System Requirements

The system furnished under this specification shall consist of the standard products of a manufacturer regularly engaged in the production of lightning protection systems and shall be the manufacturer's latest UL approved design. The lightning protection system shall conform to NFPA 70 and NFPA 780, UL 96 and UL 96A, except where requirements in excess thereof are specified herein.

## 1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

### SD-02 Shop Drawings

Drawings; G, AO.

Detail drawings consisting of a complete list of material, including manufacturer's descriptive and technical literature, catalog cuts, drawings, and installation instructions. Detail drawings shall demonstrate that the system has been coordinated and will function as a unit. Drawings shall show proposed layout and mounting and relationship to other parts of the work.

### SD-07 Certificates

#### Materials

Where material or equipment is specified to comply with requirements of UL, proof of such compliance. The label of or listing in UL Elec Const Dir will be acceptable evidence. In lieu of the label or listing, a written certificate from an approved nationally recognized testing organization equipped to perform such services, stating that the items have been tested and conform to the requirements and testing methods of Underwriters Laboratories may be submitted. A letter of findings shall be submitted certifying UL inspection of lightning protection systems provided on the facility.

## PART 2 PRODUCTS

### 2.1 MATERIALS

#### 2.1.1 General Requirements

No combination of materials shall be used that form an electrolytic couple of such nature that corrosion is accelerated in the presence of moisture unless moisture is permanently excluded from the junction of such metals. Where unusual conditions exist which would cause corrosion of conductors, conductors with protective coatings or oversize conductors shall be used. Where a mechanical hazard is involved, the conductor size shall be

increased to compensate for the hazard or the conductors shall be protected by covering them with molding or tubing made of wood or nonmagnetic material. When metallic conduit or tubing is used, the conductor shall be electrically connected at the upper and lower ends.

#### 2.1.2 Main and Secondary Conductors

Conductors shall be in accordance with NFPA 780 and UL 96 for Class I, Class II, or Class II modified materials as applicable. Main conductors shall be No. 4/0 AWG copper.

##### 2.1.2.1 Copper

Copper conductors used on nonmetallic stacks shall weigh not less than 170 kg per 300 m (375 pounds per thousand feet), and the size of any wire in the cable shall be not less than No. 15 AWG. The thickness of any web or ribbon used on stacks shall be not less than No. 12 AWG. Counterpoise shall be copper conductors not smaller than No. 4/0 AWG.

##### 2.1.2.2 Aluminum

Aluminum shall not be used.

#### 2.1.3 Air Terminals

Terminals shall be in accordance with UL 96 and NFPA 780 and shall be copper. Air terminals more than 600 mm in length shall be supported by a suitable brace, with guides not less than one-half the height of the terminal.

#### 2.1.4 Ground Rods

Rods made of copper-clad steel shall conform to UL 467. Ground rods shall be not less than 19.1 mm (3/4 inch) in diameter and 3.048 m (10 feet) in length. Ground rods of different types shall not be mixed on the job.

#### 2.1.5 Connectors

Clamp-type connectors for splicing conductors shall conform to UL 96, class as applicable, and, Class 2, style and size as required for the installation. Clamp-type connectors shall only be used for the connection of the roof conductor to the air terminal and to the guttering. All other connections, bonds, and splices shall be done by exothermic welds or by high compression fittings. The exothermic welds and high compression fittings shall be listed for the purpose. The high compression fittings shall be the type which require a hydraulically operated mechanism to apply a minimum of 10,000 psi. Appropriate precautions shall be observed at connections with dissimilar metals.

#### 2.1.6 Lightning Protection Components

Lightning protection components, such as bonding plates, air terminal supports, chimney bands, clips, and fasteners shall conform to UL 96, classes as applicable.

### PART 3 EXECUTION

#### 3.1 INTEGRAL SYSTEM

##### 3.1.1 General Requirements



The lightning protection system shall consist of air terminals, roof conductors, down conductors, ground connections, and grounds, electrically interconnected to form the shortest distance to ground. All conductors on the structures shall be concealed except where conductors are on flat roof sections. Secondary conductors shall interconnect with grounded metallic parts within the building. Interconnections made within side-flash distances shall be at or above the level of the grounded metallic parts. The system shall provide protection for the facility, interconnect with the existing facility and all associated exterior equipment, walls and fences, except lighting poles. Additionally, the protection system shall incorporate future equipment height of 2000 mm above the antenna pad, located on the roof.

#### 3.1.1.1 Air Terminals

Air terminal design and support shall be in accordance with NFPA 780. Terminals shall be rigidly connected to, and made electrically continuous with, roof conductors by means of pressure connectors or crimped joints of T-shaped malleable metal and connected to the air terminal by a dowel or threaded fitting. Air terminals at the ends of the structure shall be set not more than 600 mm (2 feet) from the ends of the ridge or edges and corners of roofs. Spacing of air terminals 600 mm (2 feet) in height on ridges, parapets, and around the perimeter of buildings with flat roofs shall not exceed 7.5 meters. In specific instances where it is necessary to exceed this spacing, the specified height of air terminals shall be increased not less than 50 mm for each 300 mm of increase over 7.5 meters. On large, flat or gently sloping roofs, as defined in NFPA 780, air terminals shall be placed at points of the intersection of imaginary lines dividing the surface into rectangles having sides not exceeding 15 m in length. Air terminals shall be secured against overturning either by attachment to the object to be protected or by means of a substantial tripod or other braces permanently and rigidly attached to the building or structure. Metal projections and metal parts of buildings, smokestacks, and other metal objects that do not contain hazardous materials and that may be struck but not appreciably damaged by lightning, need not be provided with air terminals. However, these metal objects shall be bonded to the lightning conductor through a metal conductor of the same unit weight per length as the main conductor. Where metal ventilators are installed, air terminals shall be mounted thereon. Any air terminal erected by necessity adjacent to a metal ventilator shall be bonded to the ventilator near the top and bottom. Where metal ventilators are installed with air terminals mounted thereon, the air terminal shall not be more than 610 mm away from the farther edge or corner. If the air terminal is farther than this distance, an additional air terminal shall be added in order to meet this requirement. Where metal ventilators are installed with air terminals mounted adjacent, the air terminal shall not be more than 610 mm away from the farther edge or corner. If the air terminal is farther than this distance, an additional air terminal shall be added in order to meet this requirement.

#### 3.1.1.2 Roof Conductors

Roof conductors shall be connected directly to the roof or ridge roll. Sharp bends or turns in conductors shall be avoided. Necessary turns shall have a radius of not less than 200 mm. Conductors shall preserve a downward or horizontal course and shall be rigidly fastened every 900 mm along the roof and down the building to ground. Metal ventilators shall be rigidly connected to the roof conductor at three places. All connections

shall be electrically continuous. Roof conductors shall be coursed along the contours of flat roofs, ridges, parapets, and edges; and where necessary, over flat surfaces, in such a way as to join each air terminal to all the rest. Roof conductors surrounding tank tops, decks, flat surfaces, and flat roofs shall be connected to form a closed loop.

#### 3.1.1.3 Down Conductors

Down conductors shall be electrically continuous from air terminals and roof conductors to grounding electrodes. Down conductors shall be run concealed within the Building in PVC conduit. Each building or structure shall have not less than two down conductors located as widely separated as practicable, at diagonally opposite corners. On rectangular structures having gable, hip, or gambrel roofs more than 35 m long, there shall be at least one additional down conductor for each additional 15 m of length or fraction thereof. On rectangular structures having French, flat, or sawtooth roofs exceeding 75 m in perimeter, there shall be at least one additional down conductor for each 30 m of perimeter or fraction thereof. On an L- or T-shaped structure, there shall be at least one additional down conductor; on an H-shaped structure, at least two additional down conductors; and on a wing-built structure, at least one additional down conductor for each wing. On irregularly shaped structures, the total number of down conductors shall be sufficient to make the average distance between them along the perimeter not greater than 30 meters. On structures exceeding 15 m in height, there shall be at least one additional down conductor for each additional 18 m of height or fraction thereof, except that this application shall not cause down conductors to be placed about the perimeter of the structure at intervals of less than 15 meters. Additional down conductors shall be installed when necessary to avoid "dead ends" or branch conductors ending at air terminals, except where the air terminal is on a roof below the main protected level and the "dead end" or branch conductor is less than 5 m in length and maintains a horizontal or downward coursing. Down conductors shall be equally and symmetrically spaced about the perimeter of the structure. Down conductors shall be protected by placing in pvc conduit for a minimum distance of 1800 mm 72 inches above finished grade level.

#### 3.1.1.4 Interconnection of Metallic Parts

Metal doors, windows, and gutters shall be connected directly to the grounds or down conductors using not smaller than No. 6 copper conductor, or equivalent. Conductors placed where there is probability of unusual wear, mechanical injury, or corrosion shall be of greater electrical capacity than would normally be used, or shall be protected. The ground connection to metal doors and windows shall be by means of mechanical ties under pressure, or equivalent.

#### 3.1.1.5 Ground Connections

Ground connections comprising continuations of down conductors from the structure to the grounding electrode shall securely connect the down conductor and ground in a manner to ensure electrical continuity between the two. All connections shall be of the clamp type. There shall be a ground connection for each down conductor. Metal water pipes and other large underground metallic objects shall be bonded together with all grounding mediums. Ground connections shall be protected from mechanical injury. In making ground connections, advantage shall be taken of all permanently moist places where practicable, although such places shall be avoided if the area is wet with waste water that contains chemical

substances, especially those corrosive to metal.

#### 3.1.1.6 Grounding Electrodes

A grounding electrode shall be provided for each down conductor. A driven ground shall extend into the earth for a distance of not less than 3.0 meters. Ground rods shall be set not less than 900 mm, nor more than 2.5 m, from the structures foundation. The complete installation shall have a total resistance to ground of not more than 5 ohms. Ground rods shall be tested individually prior to connection to the system and the system as a whole shall be tested not less than 48 hours after rainfall. When the resistance of the complete installation exceeds the specified value or two ground rods individually exceed 25 ohms, the Contracting Officer shall be notified immediately. A counterpoise, shall be of No. 4/0 copper cable or equivalent material having suitable resistance to corrosion and shall be laid around the perimeter of the structure in a trench not less than 900 mm deep at a distance not less than 900 mm nor more than 2.5 m from the nearest point of the structure. All connections between ground connectors and grounds or counterpoise, and between counterpoise and grounds shall be electrically continuous.

#### 3.1.2 Steel Frame Building

The steel framework shall be made electrically continuous. Electrical continuity may be provided by bolting, riveting, or welding steel frame. The air terminals shall be connected to the structural steel framework at the ridge. Short runs of conductors shall be used as necessary to join air terminals to the metal framework so that proper placing of air terminals is maintained. Separate down conductors from air terminals to ground connections are not required. Where a grounded metal pipe water system enters the building, the structural steel framework and the water system shall be connected at the point of entrance by a ground connector. Connections to pipes shall be by means of ground clamps with lugs. Connections to structural framework shall be by means of nut and bolt or welding. All connections between columns and ground connections shall be made at the bottom of the steel columns. Ground connections to grounding electrons or counterpoise shall be run from not less than one-half of all the columns distributed equally around the perimeter of the structure at intervals averaging not more than 18 meters.

### 3.2 INTERCONNECTION OF METAL BODIES

Metal bodies of conductance shall be protected if not within the zone of protection of an air terminal. Metal bodies of conductance having an area of 0.258 square meters (400 square inches) or greater or a volume of 0.0164 cubic meters (1000 cubic inches) or greater shall be bonded to the lightning protection system using main size conductors and a bonding plate having a surface contact area of not less than 1935.5 square millimeters (3 square inches). Provisions shall be made to guard against the corrosive effect of bonding dissimilar metals. Metal bodies of inductance shall be bonded at their closest point to the lightning protection system using secondary bonding conductors and fittings. A metal body that exceeds 1.5 m in any dimension, that is situated wholly within a building, and that does not at any point come within 1.8 m of a lightning conductor or metal connected thereto shall be independently grounded.

### 3.3 FENCES

Except as indicated below, metal fences that are electrically continuous

with metal posts extending at least 600 mm into the ground require no additional grounding. Other fences shall be grounded on each side of every gate. Fences shall be grounded by means of ground rods every 300 to 450 m of length when fences are located in isolated places, and every 150 to 225 m when in proximity ( 30 m or less) to public roads, highways, and buildings. The connection to ground shall be made from the post where it is of metal and is electrically continuous with the fencing. All metal fences shall be grounded at or near points crossed by overhead lines in excess of 600 volts and at distances not exceeding 45 m on each side of line crossings.

#### 3.4 INSPECTION

The lightning protection system will be inspected by the Contracting Officer to determine conformance with the requirements of this specification. No part of the system shall be concealed until so authorized by the Contracting Officer.

-- End of Section --

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## SECTION 13110

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## SECTION 13110

## CATHODIC PROTECTION SYSTEM (SACRIFICIAL ANODE)

**11/98**

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM B 418 (1995a) Cast and Wrought Galvanic Zinc Anodes

## U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

49 CFR 192 Transportation of Natural and other Gas by Pipeline: Minimum Federal Safety Standards

## NACE INTERNATIONAL (NACE)

NACE RP0169 (1996) Control of External Corrosion on Underground or Submerged Metallic Piping Systems

NACE RP0177 (1995) Mitigation of Alternating Current and Lightning Effects on Metallic Structures and Corrosion Control Systems

NACE RP0188 (1999) Discontinuity (Holiday) Testing of Protective Coatings

NACE RP0190 (1995) External Protective Coatings for Joints, Fittings, and Valves on Metallic Underground or Submerged Pipelines and Piping Systems

NACE RP0285 (1995) Corrosion Control of Underground Storage Tank Systems by Cathodic Protection

## NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA TC 2 (1998) Electrical Polyvinyl Chloride (PVC) Tubing (EPT) and Conduit (EPC-40 and EPC-80)

NEMA WC 5 (1992; Rev 2, 1996) Thermoplastic-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy

## NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (2002) National Electrical Code

## UNDERWRITERS LABORATORIES (UL)

UL 6 (1997) Rigid Metal Conduit

UL 510 (1994; Rev thru Apr 1998) Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape

UL 514A (1996; Rev Dec 1999) Metallic Outlet Boxes

## 1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

## SD-02 Shop Drawings

Drawings; G, AO.

Six copies of detail drawings consisting of a complete list of equipment and material including manufacturer's descriptive and technical literature, catalog cuts, results of system design calculations including soil-resistivity, installation instructions and certified test data stating the maximum recommended anode current output density and the rate of gaseous production if any at that current density. Detail drawings shall contain complete wiring and schematic diagrams and any other details required to demonstrate that the system has been coordinated and will function properly as a unit.

Contractor's Modifications; G, AO.

Six copies of detail drawings showing proposed changes in location, scope of performance indicating any variations from, additions to, or clarifications of contract drawings. The drawings shall show proposed changes in anode arrangement, anode size and number, anode materials and layout details, conduit size, wire size, mounting details, wiring diagram, method for electrically-isolating each pipe, and any other pertinent information to proper installation and performance of the system.

## SD-03 Product Data

Equipment; G, AO.

Within 30 days after receipt of notice to proceed, an itemized list of equipment and materials including item number, quantity, and manufacturer of each item. The list shall be accompanied by a description of procedures for each type of testing and adjustments, including testing of coating for thickness and holidays. Installation of materials and equipment shall not commence until this submittal is approved.



#### Spare Parts.

Spare parts data for each different item of material and equipment specified, after approval of detail drawings and not later than six (6) months prior to the date of beneficial occupancy. The data shall include a complete list of parts, special tools, and supplies, with current unit prices and source of supply. One (1) spare anode of each type shall be furnished.

#### SD-06 Test Reports

##### Tests and Measurements; G, AO.

Test reports in booklet form tabulating all field tests and measurements performed, upon completion and testing of the installed system and including close interval potential survey, casing and interference tests, final system test verifying protection, insulated joint and bond tests, and holiday coating test. A certified test report showing that the connecting method has passed a 120-day laboratory test without failure at the place of connection, wherein the anode is subjected to maximum recommended current output while immersed in a three percent sodium chloride solution.

##### Contractor's Modifications; G, AO.

Final report regarding Contractor's modifications. The report shall include pipe-to-soil measurements throughout the affected area, indicating that the modifications improved the overall conditions, and current measurements for anodes. The following special materials and information are required: taping materials and conductors; zinc grounding cell, installation and testing procedures, and equipment; coating material; system design calculations for anode number, life, and parameters to achieve protective potential; backfill shield material and installation details showing waterproofing; bonding and waterproofing details; insulated resistance wire; exothermic weld equipment and material.

#### SD-07 Certificates

##### Cathodic Protection System.

Proof that the materials and equipment furnished under this section conform to the specified requirements contained in the referenced standards or publications. The label or listing by the specified agency will be acceptable evidence of such compliance.

##### Services of "Corrosion Expert"

Evidence of qualifications of the "corrosion expert."

a. The "corrosion expert's" name and qualifications shall be certified in writing to the Contracting Officer prior to the start of construction.

b. Certification shall be submitted giving the name of the firm, the number of years of experience, and a list of not less than five (5) of the firm's installations three (3) or more years

old that have been tested and found satisfactory.

#### SD-10 Operation and Maintenance Data

##### Cathodic Protection System.

Before final acceptance of the cathodic protection system, six copies of operating manuals outlining the step-by-step procedures required for system startup, operation, adjustment of current flow, and shutdown. The manuals shall include the manufacturer's name, model number, service manual, parts list, and brief description of all equipment and their basic operating features. Six copies of maintenance manual, listing routine maintenance procedures, recommendation for maintenance testing, possible breakdowns and repairs, and troubleshooting guides. The manuals shall include single-line diagrams for the system as installed; instructions in making pipe-to-reference cell and tank-to-reference cell potential measurements and frequency of monitoring; instructions for dielectric connections, interference and sacrificial anode bonds; instructions shall include precautions to ensure safe conditions during repair of pipe or other metallic systems. The instructions shall be neatly bound between permanent covers and titled "Operating and Maintenance Instructions." These instructions shall be submitted for the Contracting Officer's approval. The instructions shall include the following:

a. As-built drawings, to scale of the entire system, showing the locations of the piping, location of all anodes and test stations, locations of all insulating joints, and structure-to-reference cell potentials as measured during the tests required by Paragraph: TESTS AND MEASUREMENTS, of this section.

b. Recommendations for maintenance testing, including instructions in making pipe-to-reference cell potential measurements and frequency of testing.

c. All maintenance and operating instructions and nameplate data shall be in English.

d. Instructions shall include precautions to insure safe conditions during repair of pipe system.

##### Training Course.

The proposed Training Course Curriculum (including topics and dates of discussion) indicating that all of the items contained in the operating and maintenance instructions, as well as demonstrations of routine maintenance operations, including testing procedures included in the maintenance instructions, are to be covered.

### 1.3 GENERAL REQUIREMENTS

The Contractor shall furnish and install a complete, operating, sacrificial anode cathodic protection system in complete compliance with NFPA 70, with all applicable Federal, State, and local regulations and with minimum requirements of this contract. In addition to the minimum requirements of

these specifications, construction of gas pipelines and associated cathodic protection systems shall be in compliance with 49 CFR 192. The services required include planning, installation, adjusting and testing of a cathodic protection system, using sacrificial anodes for cathodic protection of the Water, Fire Protection, and Gas lines, their connectors and lines under the slab or floor foundation. The cathodic protection system shall include anodes, cables, connectors, corrosion protection test stations, and any other equipment required for a complete operating system providing the NACE criteria of protection as specified. Insulators are required whenever needed to insulate the pipes from any other structure. Any pipe crossing any other metal body or pipe shall have a test station. The cathodic protection shall be provided on Water, Fire Protection, and Gas pipes. The cathodic protection system shall also include all risers, vents etc., that are metallic. Design consideration shall include soil changes caused by refertilization and lawn irrigation. 1) Soil resistivities shall be used representative of the final landscaping and not the insitu condition. 2) All anodes shall be routed to a test station. 3) Each test station shall have a concrete collar. 4) Anodes, test stations and wiring shall be shown on as-builts. 5) The shop drawings shall be submitted with the maintenance manuals for the cathodic protection system.

#### 1.3.1 Services of "Corrosion Expert"

The Contractor shall obtain the services of a "corrosion expert" to supervise, inspect, and test the installation and performance of the cathodic protection system. "Corrosion expert" refers to a person, who by thorough knowledge of the physical sciences and the principles of engineering and mathematics, acquired by professional education and related practical experience, is qualified to engage in the practice of corrosion control of buried or submerged metallic surfaces. Such a person must be accredited or certified by the National Association of Corrosion Engineers (NACE) as a NACE Accredited Corrosion Specialist or a NACE certified Cathodic Protection (CP) Specialist or be a registered professional engineer who has certification or licensing that includes education and experience in corrosion control of buried or submerged metallic piping and tank systems, if such certification or licensing includes 5 years experience in corrosion control on underground metallic surfaces of the type under this contract. The "corrosion expert" shall make at least 3 visits to the project site. The first of these visits shall include obtaining soil resistivity data, acknowledging the type of pipeline coatings to be used and reporting to the Contractor the type of cathodic protection required. Once the submittals are approved and the materials delivered, the "corrosion expert" shall revisit the site to ensure the Contractor understands installation practices and laying out the components. The third visit shall involve testing the installed cathodic protection systems and training applicable personnel on proper maintenance techniques. The "corrosion expert" shall supervise installation and testing of all cathodic protection.

#### 1.3.2 Contractor's Modifications

The specified system is based on a complete system with magnesium sacrificial anodes. The Contractor may modify the cathodic protection system after review of the project, site verification, and analysis, if the proposed modifications include the anodes specified and will provide better overall system performance. The modifications shall be fully described, shall be approved by the Contracting Officer's representative, and shall meet the following criteria. The proposed system shall achieve a minimum pipe-to-soil "instant off" potential of minus 850 millivolts with reference

to a saturated copper-copper sulfate reference cell on the underground components of the piping or other metallic surface. The Contractor shall take resistivity measurements of the soil in the vicinity of the pipes and ground bed sites. Based upon the measurements taken, the current and voltage shall be required to produce a minimum of minus 850 millivolts "instant off" potential between the structure being tested and the reference cell. This potential shall be obtained over 95 percent of the metallic area. The anode system shall be designed for a life of twenty-five (25) years of continuous operation.

#### 1.3.3 Isolators

Isolators are required to insulate the indicated pipes from any other structure. Isolators shall be provided with lightning protection and a test station.

#### 1.3.4 Anode and Bond Wires

All anodes shall be reouted through a test station. Magnesium anodes shall be provided uniform distances along the metallic pipe lines. Test stations shall be used for these anodes. These anodes shall be in addition to anodes for the pipe under concrete slab and casing requirements. For each cathodic system, the metallic components and structures to be protected shall be made electrically continuous. This shall be accomplished by installing bond wires between the various structures. Bonding of existing buried structures may also be required to preclude detrimental stray current effects and safety hazards. Provisions shall be included to return stray current to its source without damaging structures intercepting the stray current. The electrical isolation of underground facilities in accordance with acceptable industry practice shall be included under this section. All tests shall be witnessed by the Contracting Officer.

#### 1.3.5 Surge Protection

Approved zinc grounding cells or sealed weatherproof lightning arrestor devices shall be installed across insulated flanges or fittings installed in underground piping as indicated on the drawings. The arrestor shall be gapless, self-healing, solid state type. Zinc anode composition shall conform to ASTM B 418, Type II. Lead wires shall be number 6 AWG copper with high molecular weight polyethylene (HMWPE) insulation. The zinc grounding cells shall not be prepackaged in backfill but shall be installed as detailed on the drawings. Lightning arrestors or zinc grounding cells are not required for insulated flanges on metallic components used on nonmetallic piping systems.

#### 1.3.6 Summary of Services Required

The scope of services shall include, but shall not be limited to, the following:

- a. Close-interval potential surveys.
- b. Cathodic Protection Systems.
- c. System testing.
- d. Casing corrosion control.

- e. Interference testing.
- f. Training.
- g. Operating and maintenance manual.
- h. Insulator testing and bonding testing.

i. Coating and holiday testing shall be submitted within 45 days of notice to proceed.

#### 1.3.7 Nonmetallic Pipe System

In the event pipe other than metallic pipe is approved and used in lieu of metallic pipe, all metallic components of this pipe system shall be protected with cathodic protection. Detailed drawings of cathodic protection for each component shall be submitted to the Contracting Officer for approval within 45 days after date of receipt of notice to proceed, and before commencement of any work.

##### 1.3.7.1 Coatings

Coatings for metallic components shall be as required for metallic fittings. Protective covering (coating and taping) shall be completed and tested on each metallic component (such as valves, hydrants and fillings). This covering shall be as required for underground metallic pipe. Each test shall be witnessed by the Contracting Officer. Coatings shall be selected, applied, and inspected in accordance with NACE RP0190 and as specified in these specifications. The use of nonmetallic pipe does not change other requirements of the specifications. Any deviations due to the use of nonmetallic pipe shall be submitted for approval.

##### 1.3.7.2 Tracer Wire

When a nonmetallic pipe line is used to extend or add to an existing metallic line, an insulated No. 8 AWG copper wire shall be thermit-welded to the existing metallic line and run the length of the new nonmetallic line. This wire shall be used as a locator tracer wire and to maintain continuity to any future extensions of the pipe line.

#### 1.3.8 Tests of Components

A minimum of four (4) tests shall be made at each metallic component in the piping system. Two (2) measurements shall be made directly over the anodes and the other two (2) tests shall be over the outer edge of the component, but at the farthest point from the anodes. Structure and pipes shall be shown with the cathodic protection equipment. All components of the cathodic protection system shall be shown on drawings, showing their relationship to the protected structure or component. A narrative shall describe how the cathodic protection system will work and provide testing at each component. Components requiring cathodic protection shall include but not be limited to the following:

- a. Pipes under the floor slab or foundations.
- b. PIV.
- c. Shutoff valves.

- d. Metallic pipe extended from aboveground locations.
- e. Each connector or change-of-direction device.
- f. Any metallic pipe component or section.
- g. Backflow preventor.
- h. Culvert.

#### 1.3.9 Drawings

Detailed drawings shall be provided showing location of anodes, insulated fittings, test stations, permanent reference cells, and bonding. Locations shall be referenced to two (2) permanent facilities or mark points.

#### 1.3.10 Electrical Potential Measurements

All potential tests shall be made at a minimum of 3 meter intervals witnessed by the Contracting Officer. Submittals shall identify test locations on separate drawing, showing all metal to be protected and all cathodic protection equipment. Test points equipment and protected metal shall be easily distinguished and identified.

#### 1.3.11 Achievement of Criteria for Protection

All conductors, unless otherwise shown, shall be routed to or through the test stations. Each system provided shall achieve a minimum pipe-to-soil "instant off" potential of minus 850 millivolt potentials with reference to a saturated copper-copper-sulfate reference cell on all underground components of the piping. Based upon the measurements taken, the current and voltage of the anodes should be adjusted as required to produce a minimum of minus 850 millivolts "instant off" potential between the structure being tested and the reference cell. This potential should be obtained over 95 percent of the metallic area. This must be achieved without the "instant off" potential exceeding 1150 millivolts. Testing will be witnessed by the Contracting Officer. Additional anodes shall be provided by the Contractor if required to achieve the minus 850 millivolts "instant off". Although acceptance criteria of the cathodic protection systems are defined in NACE RP0169, for this project the "instant off" potential of minus 850 millivolts is the only acceptable criteria.

#### 1.3.12 Metallic Components and Typicals

a. Metallic components: As a minimum, each metallic component shall be protected with two (2) magnesium anodes. This number of anodes is required to achieve minus 850 millivolts "instant off" potential on the metallic area and at the same time not provide overvoltage above 1150 millivolts "instant off." The magnesium anodes shall be located on each side of the metallic component and routed through a test station.

b. Fire Hydrants: Fire hydrant pipe components shall have a minimum of two (2) anodes. These magnesium anodes shall have an unpackaged weight of 7.7 kilograms (17 lbs).

c. Pipe Under Concrete Slab: Pipe under concrete slab shall have a minimum of 2 magnesium anodes. Pipe under concrete slab shall have 1 permanent reference electrodes located under the slab. One (1) permanent reference electrode shall be located where the pipe enters the concrete

slab. All conductors shall be routed to a test station.

d. Valves: Each valve shall be protected with 2 magnesium anodes.

e. Metallic Pipe Component or Section: Each section of metallic pipe shall be protected with 2 magnesium anodes.

f. Connectors or Change-of-Direction Devices: Each change-of-direction device shall be protected with 2 magnesium anodes.

#### 1.3.13 Metallic Component Coating

Coatings for metallic components shall be as required for metallic fittings as indicated. This will include fire hydrants, T's, elbows, valves, etc. Coatings shall be selected, applied, and inspected in accordance with NACE RP0190 and as specified in these specifications.

### PART 2 PRODUCTS

#### 2.1 MAGNESIUM ANODES

Anodes sizes, composition and quantities shall be as specified and designed by the corrosion expert.

##### 2.1.1 Connecting Wire

###### 2.1.1.1 Wire Requirements

Wire shall be No. 12 AWG solid copper wire, not less than 3 meters long, unspliced, complying with NFPA 70, Type TW RHH insulation. Connecting wires for magnesium anodes shall be factory installed with the place or emergence from the anode in a cavity sealed flush with a dielectric sealing compound.

###### 2.1.1.2 Anode Header Cable

Cable for anode header and distribution shall be stranded copper wire with type CP high molecular weight polyethylene, 2.8 mm thick insulation, 600-volt rating, in accordance with NEMA WC 5. Size shall be determined by the corrosion expert.

#### 2.2 MISCELLANEOUS MATERIALS

##### 2.2.1 Electrical Wire

Wire shall be stranded copper wire with NFPA 70, Type TW insulation. Size shall be determined by the corrosion expert.

###### 2.2.1.1 Wire Splicing

Connecting wire splicing shall be made with copper compression connectors or exothermic welds, following instructions of the manufacturer. Single split-bolt connections shall not be used. Sheaths for encapsulating electrical wire splices to be buried underground shall fit the insulated wires entering the spliced joints and epoxy potting compound shall be as specified below.

###### 2.2.1.2 Test Wires

Test wires shall be AWG No. 12 stranded copper wire with NFPA 70, Type TW or RHW or polyethylene insulation.

#### 2.2.1.3 Resistance Wire

Resistance wire shall be AWG No. 16 or No. 22 nickel-chromium wire.

#### 2.2.2 Conduit

Rigid galvanized steel conduit and accessories shall conform to UL 6. Non metallic conduit shall conform to NEMA TC 2.

#### 2.2.3 Test Boxes and Junctions Boxes

Boxes shall be outdoor type conforming to UL 514A.

#### 2.2.4 Joint, Patch, Seal, and Repair Coating

Sealing and dielectric compound shall be a black, rubber based compound that is soft, permanently pliable, tacky, moldable, and unbacked. Compound shall be applied as recommended by the manufacturer, but not less than 13 mm thick. Coating compound shall be hot-applied coal-tar enamel. Pressure-sensitive vinyl plastic electrical tape shall conform to UL 510.

#### 2.2.5 Backfill Shields

Shields shall consist of approved pipeline wrapping or fiberglass-reinforced, coal-tar impregnated tape, or plastic weld caps, specifically made for the purpose and installed in accordance with the manufacturer's recommendations. When joint bonds are required, due to the use of mechanical joints, the entire joint shall be protected by the use of a kraft paper joint cover. The joint cover shall be filled with poured-in, hot coat-tar enamel.

#### 2.2.6 Epoxy Potting Compound

Compound for encapsulating electrical wire splices to be buried underground shall be a two package system made for the purpose.

#### 2.2.7 Test Stations

Stations shall be of the flush-curb-box type and shall be the standard product of a recognized manufacturer. Test stations shall be complete with an insulated terminal block having the required number of terminals. The test station shall be provided with a lockable over and shall have an embossed legend, "C.P. Test." A minimum of one (1) test station shall be provided each component of the pipe. A minimum of six (6) terminals shall be provided in each test station. A minimum of two (2) leads are required to the metallic pipe from each test station. Other conductors shall be provided for each anode, other foreign pipe, and reference cells as required.

#### 2.2.8 Joint and Continuity Bonds

Bonds shall be provided across all joints in the metallic water and gas lines, across any electrically discontinuous connections and all other pipes and structures with other than welded or threaded joints that are included in this cathodic protection system. Unless otherwise specified in the specifications, bonds between structures and across joints in pipe with



other than welded or threaded joints shall be No. 8 AWG stranded copper cable with polyethylene insulation. Bonds between structures shall contain sufficient slack for any anticipated movement between structures. Bonds across pipe joints shall contain a minimum of 102 mm of slack to allow for pipe movement and soil stress. Bonds shall be attached by exothermic welding. Exothermic weld areas shall be insulated with coating compound and approved, and witnessed by the Contracting Officer. Continuity bonds shall be installed as necessary to reduce stray current interference. Additional joint bondings shall be accomplished by the Contractor where the necessity is discovered during construction or testing or where the Contracting Officer's representative directs that such bonding be done. Joint bonding shall include all associated excavation and backfilling. There shall be a minimum of two (2) continuity bonds between each structure and other than welded or threaded joints. The Contractor shall test for electrical continuity across all joints with other than welded or threaded joints and across all metallic portions or components. The Contractor shall provide bonding as required and as specified above until electrical continuity is achieved. Bonding test data shall be submitted for approval.

#### 2.2.9 Resistance Bonds

Resistance bonds should be adjusted as outlined in this specification. Alternate methods may be used if they are approved by the Contracting Officer.

#### 2.2.10 Stray Current Measurements

Stray current measurements should be performed at each test station. Stray currents resulting from lightning or overhead alternating current (AC) power transmission systems shall be mitigated in accordance with NACE RP0177.

#### 2.2.11 Electrical Isolation of Structures

As a minimum, isolating flanges or unions shall be provided at the following locations:

- a. Connection of new metallic piping or components to existing piping.
- b. Pressure piping under floor slab to a building.

Isolation shall be provided at metallic connection of all lines to existing system and where connecting to a building. Additionally, isolation shall be provided between water and/or gas line; and foreign pipes that cross the new lines within 3.05 m. Isolation fittings, including isolating flanges and couplings, shall be installed aboveground or in a concrete pit.

##### 2.2.11.1 Electrically Isolating Pipe Joints

Electrically isolating pipe joints shall be of a type that is in regular factory production.

##### 2.2.11.2 Electrically Conductive Couplings

Electrically conductive couplings shall be of a type that has a published maximum electrical resistance rating given in the manufacturer's literature. Cradles and seals shall be of a type that is in regular factory production made for the purpose of electrically insulating the carrier pipe from the casing and preventing the incursion of water into the

annular space.

#### 2.2.11.3 Insulating Joint Testing

A Model 601 Insulation Checker, as manufactured by "Gas Electronics", or an approved equal, shall be used for insulating joint (flange) electrical testing.

#### 2.2.12 Underground Structure Coating

This coating specification shall take precedence over any other project specification and drawing notes, whether stated or implied, and shall also apply to the pipeline or tank supplier. No variance in coating quality shall be allowed by the Contractor or Base Construction Representative without the written consent of the designer. All underground metallic pipelines and tanks to be cathodically protected shall be afforded a good quality factory-applied coating. This includes all carbon steel, cast-iron and ductile-iron pipelines or vessels. Coatings shall be selected, applied, and inspected in accordance with NACE RP0190 and as specified. If non-metallic pipelines are installed, all metallic fittings on pipe sections shall be coated in accordance with this specification section.

a. Pipe and joint coating for factory applied or field repair material shall be applied as recommended by the manufacturer and shall be one of the following:

- (1) Continuously extruded polyethylene and adhesive coating system.
- (2) Polyvinyl chloride pressure-sensitive adhesive tape.
- (3) High density polyethylene/bituminous rubber compound tape.
- (4) Butyl rubber tape.
- (5) Coal tar epoxy.

#### 2.2.12.1 Field Joints

All field joints shall be coated with materials compatible with the pipeline coating compound. The joint coating material shall be applied to an equal thickness as the pipeline coating. Unbonded coatings shall not be used on these buried metallic components. This includes the elimination of all unbonded polymer wraps or tubes. Once the pipeline or vessel is set in the trench, an inspection of the coating shall be conducted. This inspection shall include electrical holiday detection. Any damaged areas of the coating shall be properly repaired. The Contracting Officer shall be asked to witness inspection of the coating and testing using a holiday detector.

#### 2.2.12.2 Inspection of Pipe Coatings

Any damage to the protective covering during transit and handling shall be repaired before installation. After field coating and wrapping has been applied, the entire pipe shall be inspected by an electric holiday detector with impressed current in accordance with NACE RP0188 using a full-ring, spring-type coil electrode. The holiday detector shall be equipped with a bell, buzzer, or other type of audible signal which sounds when a holiday is detected. All holidays in the protective covering shall be repaired immediately upon detection. Occasional checks of holiday detector potential will be made by the Contracting Officer's representative to determine suitability of the detector. All labor, materials, and equipment necessary for conducting the inspection shall be furnished by the

Contractor.

a. Protective covering for aboveground piping system: Finish painting shall conform to the applicable paragraph of SECTION: 09900, PAINTING, GENERAL, and as follows:

b. Ferrous surfaces: Shop-primed surfaces shall be touched-up with ferrous metal primer. Surfaces that have not been shop-primed shall be solvent-cleaned. Surfaces that contain loose rust, loose mil scale, and other foreign substances shall be mechanically-cleaned by power wire-brushing and primed with ferrous metal primer. Primed surface shall be finished with two (2) coats of exterior oil paint and vinyl paint. Coating for each entire piping service shall be an approved pipe line wrapping having a minimum coating resistance of 50,000 Ohms per 0.0929 square meters .

#### 2.2.13 Resistance Wire

Wire shall be No. 16 or No. 22 nickel-chromium wire with TW insulation.

#### 2.2.14 Electrical Connections

Electrical connections shall be done as follows:

a. Exothermic welds shall be "Cadweld", "Bundy", "Thermoweld" or an approved equal. Use of this material shall be in strict accordance with the manufacturer's recommendations.

b. Electrical-shielded arc welds shall be approved for use on steel pipe by shop drawing submittal action.

c. Brazing shall be as specified in Paragraph: Lead Wire Connections.

#### 2.2.15 Electrical Tape

Pressure-sensitive vinyl plastic electrical tape shall conform to UL 510.

#### 2.2.16 Permanent Reference Electrodes

Permanent reference electrodes shall be Cu-CuSO<sub>4</sub> electrodes suitable for direct burial. Electrodes shall be guaranteed by the supplier for 15 years' service in the environment in which they shall be placed. Electrodes shall be installed directly beneath pipe, or metallic component.

#### 2.2.17 Casing

Where a pipeline is installed in a casing under a roadway or railway, the pipeline shall be electrically insulated from the casing, and the annular space sealed and filled with an approved corrosion inhibiting product against incursion of water.

### PART 3 EXECUTION

#### 3.1 CRITERIA OF PROTECTION

Acceptance criteria for determining the adequacy of protection on a buried underground pipe or metallic component shall be in accordance with NACE RP0169 NACE RP0285 and as specified below.

### 3.1.1 Iron and Steel

The following method (a) shall be used for testing cathodic protection voltages. If more than one method is required, method (b) shall be used.

a. A negative voltage of at least minus 850 millivolts as measured between the underground component and a saturated copper-copper sulphate reference electrode connecting the earth (electrolyte) directly over the underground component. Determination of this voltage shall be made with the cathodic protection system in operation. Voltage drops shall be considered for valid interpretation of this voltage measurement. A minimum of minus 850 millivolts "instant off" potential between the underground component being tested and the reference cell shall be achieved over 95 percent of the area of the structure. Adequate number of measurements shall be obtained over the entire structure, pipe, tank, or other metallic component to verify and record achievement of minus 850 millivolts "instant off." This potential shall be obtained over 95 percent of the total metallic area without the "instant off" potential exceeding 1200 millivolts.

b. A minimum polarization voltage shift of 100 millivolts as measured between the underground component and a saturated copper-copper sulphate reference electrode contacting the earth directly over the underground component. This polarization voltage shift shall be determined by interrupting the protective current and measuring the polarization decay. When the protective current is interrupted, an immediate voltage shift will occur. The voltage reading, after the immediate shift, shall be used as the base reading from which to measure polarization decay. Measurements achieving 100 millivolts decay shall be made over 95 percent of the metallic surface being protected.

c. For any metallic component, a minimum of four (4) measurements shall be made using subparagraph (a), above, and achieving the "instant off" potential of minus 850 millivolts. Two (2) measurements shall be made over the anodes and two (2) measurements shall be made at different locations near the component and farthest away from the anode.

### 3.1.2 Aluminum

Aluminum underground component shall not be protected to a potential more negative than minus 1200 millivolts, measured between the underground component and a saturated copper-copper sulphate reference electrode contacting the earth, directly over the metallic component. Resistance, if required, shall be inserted in the anode circuit within the test station to reduce the potential of the aluminum to a value which will not exceed a potential more negative than minus 1200 millivolts. Voltage shift criterion shall be a minimum negative polarization shift of 100 millivolts measured between the metallic component and a saturated copper-copper sulphate reference electrode contacting the earth, directly over the metallic component. The polarization voltage shift shall be determined as outlined for iron and steel.

### 3.1.3 Copper Piping

For copper piping, the following criteria shall apply: A minimum of 100 millivolts of cathodic polarization between the structure surface and a stable reference electrode contacting the electrolyte. The polarization voltage shift shall be determined as outlined for iron and steel.

### 3.2 ANODE STORAGE AND INSTALLATION

#### 3.2.1 Anode Storage

Storage area for magnesium anodes will be designated by the Contracting Officer. If anodes are not stored in a building, tarps or similar protection should be used to protect anodes from inclement weather. Packaged anodes, damaged as a result of improper handling or being exposed to rain, shall be resacked by the Contractor and the required backfill added.

#### 3.2.2 Anode Installation

Unless otherwise authorized, installation shall not proceed without the presence of the Contracting Officer. Anodes of the size specified shall be installed to the depth indicated and at the locations shown. Locations may be changed to clear obstructions with the approval of the Contracting Officer. Anodes shall be installed in sufficient number and of the required type, size, and spacing to obtain a uniform current distribution over the surface of the structure. The anode system shall be designed for a life of 25 years of continuous operation. Anodes shall be installed as indicated in a dry condition after any plastic or waterproof protective covering has been completely removed from the water permeable, permanent container housing the anode metal. The anode connecting wire shall not be used for lowering the anode into the hole. The annular space around the anode shall be backfilled with fine earth in 150 mm layers and each layer shall be hand tamped. Care must be exercised not to strike the anode or connecting wire with the tamper. Approximately 20 liters of water shall be applied to each filled hole after anode backfilling and tamping has been completed to a point about 150 mm above the anode. After the water has been absorbed by the earth, backfilling shall be completed to the ground surface level.

##### 3.2.2.1 Single Anodes

Single anodes, spaced as shown, shall be connected through a test station to the pipeline, allowing adequate slack in the connecting wire to compensate for movement during backfill operation.

##### 3.2.2.2 Groups of Anodes

Groups of anodes, in quantity and location shown, shall be connected to an anode header cable. The anode header cable shall make contact with the structure to be protected only through a test station. Anode lead connection to the anode header cable shall be made by an approved crimp connector or exothermic weld and splice mold kit with appropriate potting compound.

##### 3.2.2.3 Welding Methods

Connections to ferrous pipe shall be made by exothermic weld methods manufactured for the type of pipe supplied. Electric arc welded connections and other types of welded connections to ferrous pipe and structures shall be approved before use.

##### 3.2.3 Anode Placement - General

Packaged anodes shall be installed completely dry, and shall be lowered into holes by rope sling or by grasping the cloth gather. The anode lead wire shall not be used in lowering the anodes. The hole shall be backfilled with fine soil in 150 mm layers and each layer shall be hand-tamped around the anode. Care must be exercised not to strike the anode or lead wire with the tamper. If immediate testing is to be performed, water shall be added only after backfilling and tamping has been completed to a point 150 mm above the anode. Approximately 8 liters of water may be poured into the hole. After the water has been absorbed by the soil, backfilling and tamping may be completed to the top of the hole. Anodes shall be installed as specified or shown. In the event a rock strata is encountered prior to achieving specified augered-hole depth, anodes may be installed horizontally to a depth at least as deep as the bottom of the pipe, with the approval of the Contracting Officer.

#### 3.2.4 Underground Pipeline

Anodes shall be installed at a minimum of 2.5 meters and a maximum of 3 meters from the line to be protected.

#### 3.2.5 Installation Details

Details shall conform to the requirements of this specification and as provided by the corrosion expert.

#### 3.2.6 Lead Wire Connections

##### 3.2.6.1 Underground Pipeline (Metallic)

To facilitate periodic electrical measurements during the life of the sacrificial anode system and to reduce the output current of the anodes, if required, all anode lead wires shall be connected to a test station and buried a minimum of 610 mm in depth. The cable shall be No. 10 AWG, stranded copper, polyethylene or RHW-USE insulated cable. The cable shall make contact with the structure only through a test station. Resistance wire shall be installed between the cable and the pipe cable, in the test station, to reduce the current output, if required. Anode connections, except in the test station, shall be made with exothermic welding process, and shall be insulated by means of at least three (3) layers of electrical tape; and all lead wire connections shall be installed in a moistureproof splice mold kit and filled with epoxy resin. Lead wire-to-structure connections shall be accomplished by an exothermic welding process. All welds shall be in accordance with the manufacturer's recommendations. A backfill shield filled with a pipeline mastic sealant or material compatible with the coating shall be placed over the weld connection and shall be of such diameter as to cover the exposed metal adequately.

##### 3.2.6.2 Resistance Wire Splices

Resistance wire connections shall be accomplished with silver solder and the solder joints wrapped with a minimum of three (3) layers of pressure-sensitive tape. Lead wire connections shall be installed in a moistureproof splice mold kit and filled with epoxy resin.

#### 3.2.7 Location of Test Stations

Test stations shall be of the type and location determined by the corrosion expert and shall be curb box with a concrete collar mounted. Buried insulating joints shall be provided with test wire connections brought to a

test station. Unless otherwise shown, other test stations shall be located as follows:

- a. At 300 m intervals or less.
- b. Where the pipe or conduit crosses any other metal pipe.
- c. At both ends of casings under roadways and railways.
- d. Where both sides of an insulating joint are not accessible above ground for testing purposes.

### 3.2.8 Underground Pipe Joint Bonds

Underground pipe having other than welded or threaded coupling joints shall be made electrically continuous by means of a bonding connection installed across the joint.

## 3.3 ELECTRICAL ISOLATION OF STRUCTURES

### 3.3.1 Isolation Joints and Fittings

Isolating fittings, including main line isolating flanges and couplings, shall be installed aboveground, or within manholes, wherever possible. Where isolating joints must be covered with soil, they shall be fitted with a paper joint cover specifically manufactured for covering the particular joint, and the space within the cover filled with hot coal-tar enamel. Isolating fittings in lines entering buildings shall be located at least 305 mm above grade of floor level, when possible. Isolating joints shall be provided with grounding cells to protect against over-voltage surges or approved surge protection devices. The cells shall provide a low resistance across isolating joint without excessive loss of cathodic current. Pipelines entering buildings either below or above ground shall be electrically isolated from the structure wall and concrete floor slab with an electrically isolating type sleeve.

### 3.3.2 Gas Distribution Piping

Electrical isolation shall be provided at each building riser pipe to the pressure regulator, at all points where a short to another structure or to a foreign structure may occur.

## 3.4 TRENCHING AND BACKFILLING

Trenching and backfilling shall be in accordance with Section 02316 EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITY SYSTEMS.

## 3.5 TESTS AND MEASUREMENTS

### 3.5.1 Baseline Potentials

Each test and measurement will be witnessed by the Contracting Officer. The Contractor shall notify the Contracting Officer a minimum of five (5) working days prior to each test. After backfill of the pipe, the static potential-to-soil of the pipe shall be measured. The locations of these measurements shall be identical to the locations specified for pipe-to-reference electrode potential measurements. The initial measurements shall be recorded.

### 3.5.2 Isolation Testing

Before the anode system is connected to the pipe, an isolation test shall be made at each isolating joint or fitting. This test shall demonstrate that no metallic contact, or short circuit exists between the two isolated sections of the pipe. Any isolating fittings installed and found to be defective shall be reported to the Contracting Officer.

#### 3.5.2.1 Insulation Checker

A Model 601 insulation checker, as manufactured by "Gas Electronics", or an approved equal, using the continuity check circuit, shall be used for isolating joint (flange) electrical testing. Testing shall conform to the manufacturer's operating instructions. Test shall be witnessed by the Contracting Officer. An isolating joint that is good will read full scale on the meter. If an isolating joint is shorted, the meter pointer will be deflected or near zero on the meter scale. Location of the fault shall be determined from the instructions, and the joint shall be repaired. If an isolating joint is located inside a vault, the pipe shall be sleeved with insulator when entering and leaving the vault.

#### 3.5.2.2 Cathodic Protection Meter

A Model B3A2 cathodic protection meter, as manufactured by "M.C. Miller", or an approved equal, using the continuity check circuit, shall be used for isolating joint (flange) electrical testing. This test shall be performed in addition to the Model 601 insulation checker. Continuity is checked across the isolation joint after the test lead wire is shorted together and the meter adjusted to scale. A full-scale deflection indicates the system is shorted at some location. The Model 601 verifies that the particular insulation under test is good and the Model B3A2 verifies that the system is isolated. If the system is shorted, further testing shall be performed to isolate the location of the short.

### 3.5.3 Anode Output

As the anodes or groups of anodes are connected to the pipe, current output shall be measured with an approved clamp-on milliammeter, calibrated shunt with a suitable millivoltmeter or multimeter, or a low resistance ammeter. (Of the three methods, the low-resistance ammeter is the least desirable and most inaccurate. The clamp-on milliammeter is the most accurate.) The valves obtained and the date, time, and location shall be recorded.

### 3.5.4 Reference Electrode Potential Measurements

Upon completion of the installation and with the entire cathodic protection system in operation, electrode potential measurements shall be made using a copper-copper sulphate reference electrode and a potentiometer-voltmeter, or a direct-current voltmeter having an internal resistance (sensitivity) of not less than 10 megohms per volt and a full scale of 10 volts. The locations of these measurements shall be identical to the locations used for baseline potentials. The values obtained and the date, time, and locations of measurements shall be recorded. No less than eight (8) measurements shall be made over any length of line or component. Additional measurements shall be made at each distribution service riser, with the reference electrode placed directly over the service line.

### 3.5.5 Location of Measurements



#### 3.5.5.1 Piping or Conduit

For coated piping or conduit, measurements shall be taken from the reference electrode located in contact with the earth, directly over the pipe. Connection to the pipe shall be made at service risers, valves, test leads, or by other means suitable for test purposes. Pipe-to-soil potential measurements shall be made at intervals not exceeding 3 meters. Additional measurements shall be made at each distribution service riser, with the reference electrode placed directly over the service line adjacent to the riser. Potentials shall be plotted versus distance to an approved scale. Locations where potentials do not meet or exceed the criteria shall be identified and reported to the Contracting Officer's representative.

#### 3.5.5.2 Casing Tests

Before final acceptance of the installation, the electrical separation of carrier pipe from casings shall be tested and any short circuits corrected.

#### 3.5.5.3 Interference Testing

Before final acceptance of the installation, interference tests shall be made with respect to any foreign pipes in cooperation with the owner of the foreign pipes or tanks. A full report of the tests giving all details shall be made. Stray current measurements shall be performed at all isolating locations and at locations where the new pipeline crosses foreign metallic pipes. The method of measurements and locations of measurements shall be submitted for approval. As a minimum, stray current measurements shall be performed at the following locations:

- a. Connection point of new pipeline to existing pipeline.
- b. Crossing points of new pipeline with existing lines.

Results of stray current measurements shall also be submitted for approval.

#### 3.5.5.4 Holiday Test

Any damage to the protective covering during transit and handling shall be repaired before installation. After field-coating and wrapping has been applied, the entire pipe shall be inspected by an electric holiday detector with impressed current in accordance with NACE RP0188 using a full-ring, spring-type coil electrode. The holiday detector shall be equipped with a bell, buzzer, or other type of audible signal which sounds when a holiday is detected. Holidays in the protective covering shall be repaired upon detection. Occasional checks of holiday detector potential will be made by the Contracting Officer to determine suitability of the detector. Labor, materials, and equipment necessary for conducting the inspection shall be furnished by the Contractor. The coating system shall be inspected for holes, voids, cracks, and other damage during installation.

#### 3.5.5.5 Recording Measurements

All pipe-to-soil potential measurements, including initial potentials where required, shall be recorded. The Contractor shall locate, correct and report to the Contracting Officer any short circuits to foreign pipes encountered during checkout of the installed cathodic protection system. Pipe-to-soil potential measurements shall be taken on as many pipes as necessary to determine the extent of protection or to locate short-circuits.

### 3.6 TRAINING COURSE

The Contractor shall conduct a training course for the operating staff as designated by the Contracting Officer. The training period shall consist of a total of 4 hours of normal working time and shall start after the system is functionally completed but prior to final acceptance tests. The field instructions shall cover all of the items contained in the operating and maintenance instructions, as well as demonstrations of routine maintenance operations, including testing procedures included in the maintenance instructions. At least 14 days prior to date of proposed conduction of the training course, the training course curriculum shall be submitted for approval, along with the proposed training date. Training shall consist of demonstration of test equipment, providing forms for test data and the tolerances which indicate that the system works.

### 3.7 CLEANUP

The Contractor shall be responsible for cleanup of the construction site. All paper bags, wire clippings, etc., shall be disposed of as directed. Paper bags, wire clippings and other waste shall not be put in bell holes or anodes excavation.

### 3.8 MISCELLANEOUS INSTALLATION AND TESTING

#### 3.8.1 Coatings

All aboveground pipeline shall be coated as indicated or as approved. The coating shall have a minimum thickness of 0.18 mm. The pipeline coating shall be in accordance with all applicable Federal, State, and local regulations.

#### 3.8.2 Excavation

In the event rock is encountered in providing the required depth for anodes, the Contractor shall determine an alternate approved location and, if the depth is still not provided, an alternate plan shall be submitted to the Contracting Officer. Alternate techniques and depths must be approved prior to implementation.

### 3.9 SPARE PARTS

After approval of shop drawings, and not later than three (3) months prior to the date of beneficial occupancy, the Contractor shall furnish spare parts data for each different item of material and equipment specified. The data shall include a complete list of parts, special tools, and supplies, with current unit prices and source of supply. In addition, the Contractor shall supply information for material and equipment replacement for all other components of the complete system, including anodes, cables, splice kits and connectors, corrosion test stations, and any other components not listed above.

### 3.10 SEEDING

Seeding shall be done by the Contractor, as directed, in all unsurfaced locations disturbed by this construction. In areas where grass cover exists, it is possible that sod can be carefully removed, watered, and stored during construction operations, and replaced after the operations are completed since it is estimated that no section of pipeline should remain uncovered for more than two (2) days. The use of sod in lieu of

seeding shall require approval by the Contracting Officer.

### 3.11 SYSTEM TESTING

The Contractor shall submit a report including potential measurements taken at adequately-close intervals to establish that minus 850 millivolts potential, "instant-off" potential, is provided, and that the cathodic protection is not providing interference to other foreign pipes causing damage to paint or pipes. The report shall provide a narrative describing how the criteria of protection is achieved without damaging other pipe or structures in the area.

### 3.12 CLEARING OF TREES AND UNDERBRUSH

In the areas of the anode beds, all trees and underbrush shall be cleared and grubbed to the limits the provide a complete and operational system as directed by the corrosion expert.

-- End of Section --

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## SECTION 13720

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## SECTION 13720

ELECTRONIC SECURITY SYSTEM  
05/98

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI X3.92 (1981; R 1993) Data Encryption Algorithm

## U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

47 CFR 15 Radio Frequency Devices

## ELECTRONIC INDUSTRIES ALLIANCE (EIA)

EIA 170 (1957) Electrical Performance Standards -  
Monochrome Television Studio Facilities

EIA ANSI/EIA-310-D (1992) Cabinets, Racks, Panels, and  
Associated Equipment

EIA ANSI/TIA/EIA-568-B (April 1, 2001) Commercial Building  
Telecommunications Cabling Standard

## INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2 (1997) National Electrical Safety Code

IEEE C62.41 (1991; R 1995) Surge Voltages in  
Low-Voltage AC Power Circuits

IEEE Std 142 (1991) IEEE Recommended Practice for  
Grounding of Industrial and Commercial  
Power Systems

## INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)

ISO 7810 (1995) Identification Cards - Physical  
Characteristics

ISO 7811-1 (1995) Identification Cards - Recording  
Technique - Part 1: Embossing

ISO 7811-2 (1995) Identification Cards - Recording  
Technique - Part 2: Magnetic Stripe

ISO 7811-3 (1995) Identification Cards - Recording  
Technique - Part 3: Location of Embossed

## Characters on ID-1 Cards

- ISO 7811-4 (1995) Identification Cards - Recording Technique - Part 4: Location of Read-Only Magnetic Tracks - Tracks 1 and 2
- ISO 7811-5 (1995) Identification Cards - Recording Technique - Part 5: Location of Read-Write Magnetic Track - Track 3

## NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

- NEMA 250 (1997) Enclosures for Electrical Equipment (1000 Volts Maximum)
- NEMA ICS 1 (1993) Industrial Control and Systems

## NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

- NFPA 70 (2002) National Electrical Code

## UNDERWRITERS LABORATORIES (UL)

- UL 294 (1999) Access Control System Units
- UL 639 (1997; Rev thru Mar 1999) Intrusion Detection Units
- UL 681 (1999) Installation and Classification of Burglar and Holdup Alarm Systems
- UL 796 (1999) Printed-Wiring Boards
- UL 1037 (1999) Antitheft Alarms and Devices
- UL 1076 (1995; Rev thru Feb 1999) Proprietary Burglar Alarm Units and Systems

## 1.2 SYSTEM DESCRIPTION

Notwithstanding Section 00700 Contract Clauses FAR 52.236-5, Material and Workmanship, Electronic Security Systems shall be manufactured by Info graphics in order that the systems installed are fully compatible and can be integrated with existing pre-wired systems within the building (or fully compatible and fully integrated and connected to the Electronic Security System) No other product will be acceptable. The Competition Advocate authorizes sole source procurement.

The Contractor shall provide an Electronic Security System (ESS) as described and shown including installation of any Government Furnished Equipment. All computing devices, as defined in 47 CFR 15, shall be certified to comply with the requirements for Class A computing devices and labeled as set forth in 47 CFR 15. Electronic equipment shall comply with 47 CFR 15.

The Contractor shall hold a meeting with the end user to determine the zoning of the security areas prior to system design. Submit the proposed zoning in a narrative and graphical form to the 550/21 sfs via the C.O.

### 1.2.1 Central Station

The central station shall be configured to provide operator interface, interaction, dynamic and real time monitoring, display, and control. The central station shall control system networks to interconnect all system components including subordinate or separate control stations, enrollment stations and field equipment. The system shall be able to manage up to 16,000 uniquely identifiable inputs and outputs. The existing central station is an Info Graphics one-32 plus system. The station is located in Building 1376. The redundant location is in Building one. Tie the Building Security systems of NorthCom Beddown/NCOC into the existing system. The systems shall interface with and be completely compatible with the existing system..

### 1.2.2 Systems Networks

System networks shall interconnect all components of the system. These networks shall include communications between a central station and any subordinate or separate station, enrollment stations, local annunciation stations, portal control stations or redundant central stations. The systems network shall provide totally automatic communication of status changes, commands, field initiated interrupts and any other communications required for proper system operation. System communication shall not require operator initiation or response. System communication shall return to normal after any partial or total network interruption such as power loss or transient upset. The system shall automatically annunciate communication failures to the operator with identification of the communication link that has experienced a partial or total failure. A communications controller may be used as an interface between the central station display systems and the field device network. The communications controller shall provide those functions needed to attain the specified network communications performance.

#### 1.2.2.1 Console Network

A console network, if required, shall provide communication between a central station and any subordinate or separate stations of the system. Where redundant central or parallel stations are required, the console network shall allow the configuration of stations as master and slave. The console network may be a part of the field device network or may be separate depending upon the manufacturer's system configuration.

#### 1.2.2.2 Field Device Network

The field device network shall provide communication between a central control station and field devices of the system. The field device network shall be configured as shown in the drawings. Field devices shall consist of alarm annunciation local processors and entry control local processors. Each field device shall be interrogated during each interrogation cycle. The field device network shall provide line supervision that detects and annunciates communications interruptions or compromised communications between any field device and the central station.

### 1.2.3 Field Equipment

Field equipment shall include local processors, sensors and controls. Local processors shall serve as an interface between the central station and sensors and controls. Data exchange between the central station and the local processors shall include down-line transmission of commands,

software and databases to local processors. The up line data exchange from the local processor to the central station shall include status data such as intrusion alarms, status reports and entry control records. Local processors are categorized as alarm annunciation or entry control.

#### 1.2.4 CCTV System Interface

An interface shall be provided for connection of the central station to the CCTV system as specified in Section 16751 CLOSED CIRCUIT TELEVISION SYSTEMS and as shown. This shall not be accomplished by using an electro-mechanical relay assembly.

#### 1.2.5 Overall System Reliability Requirements

The system, including all components and appurtenances, shall be configured and installed to yield a mean time between failure (MTBF) of at least 10,000 hours.

#### 1.2.6 Error Detection and Retransmission

A cyclic code error detection method shall be used between local processors and the central station, which shall detect single and double bit errors, burst errors of 8 bits or less, and at least 99 percent of all other multibit and burst error conditions. Interactive or product error detection codes alone will not be acceptable. A message shall be in error if 1 bit is received incorrectly. The system shall retransmit messages with detected errors. A 2-digit decimal number shall be operator assignable to each communication link representing the number of retransmission attempts. When the number of consecutive retransmission attempts equals the assigned quantity, the central station shall print a communication failure alarm message. The system shall monitor the frequency of data transmission failure for display and logging.

#### 1.2.7 System Definitions

##### 1.2.7.1 Intrusion Alarm

An alarm resulting from the detection of a specified target, caused by an attempt to intrude into the protected area, or when entry into an entry controlled area is attempted without successfully using entry control procedures.

##### 1.2.7.2 Nuisance Alarm

An alarm resulting from the detection of an appropriate alarm stimulus, but which does not represent an attempt to intrude into the protected area.

##### 1.2.7.3 Environmental Alarm

An alarm during environmental conditions which exceed those specified.

##### 1.2.7.4 False Alarm

An alarm when there is no alarm stimulus.

##### 1.2.7.5 Duress Alarm

An alarm condition which results from a set of pre-established conditions such as entering a special code into a keypad or by activating a switch.

This alarm category shall take precedence over other alarm categories.

#### 1.2.7.6 Guard Tour Alarm

An alarm resulting from a guard being either early or late at a specified check-in location.

#### 1.2.7.7 Fail-Safe Alarm

An alarm resulting from detection of diminished functional capabilities.

#### 1.2.7.8 Power Loss Alarm

An alarm resulting from a loss of primary power.

#### 1.2.7.9 Entry Control Alarm

An alarm resulting from improper use of entry control procedures or equipment.

#### 1.2.7.10 Identifier

A card credential, keypad personal identification number or code, biometric characteristic or any other unique identification entered as data into the entry control database for the purpose of identifying an individual. Identifiers shall be used by the electronic security system for the purpose of validating passage requests for areas equipped with entry control equipment.

#### 1.2.7.11 Entry Control Devices

Any equipment which gives a user the means to input identifier data into the entry control system for verification.

#### 1.2.7.12 Facility Interface Device

A facility interface device shall be any type of mechanism which is controlled in response to passage requests and allows passage through a portal.

#### 1.2.8 Probability of Detection

Each zone shall have a continuous probability of detection greater than 90 percent and shall be demonstrated with a confidence level of 95 percent. This probability of detection is defined as 49 successful detections out of 50 tests or 96 successful detections out of 100 tests.

#### 1.2.9 Standard Intruder

The system shall be able to detect an intruder that weighs 100 pounds or less and is 5 feet tall or less. The intruder shall be dressed in a long-sleeved shirt, slacks and shoes unless environmental conditions at the site require protective clothing.

##### 1.2.9.1 Standard Intruder Movement

Standard intruder movement is defined as any movement such as walking, running, crawling, rolling, or jumping through a protected zone in the most advantageous manner for the intruder.

### 1.2.10 False Alarm Rate

#### 1.2.10.1 Interior

A false alarm rate of no more than 1 false alarm per sensor per 30 days at the specified probability of detection shall be provided.

#### 1.2.10.2 Exterior

A false alarm rate of no more than 1 false alarm per sensor per 5 days at the specified probability of detection shall be provided.

### 1.2.11 Error and Throughput Rates

Error and throughput rates shall be single portal performance rates obtained when processing individuals 1 at a time.

#### 1.2.11.1 Type I Error Rate

Type I error rate is defined as an error where the system denies entry to an authorized, enrolled individual. The rate shall be less than 1 percent.

#### 1.2.11.2 Type II Error Rate

Type II error rate is defined as an error where the system grants entry to an unauthorized individual. The entry control Type II error rate shall be less than 0.01 percent.

### 1.2.12 System Throughput

At the specified error rates, the system throughput rate through a single portal shall be as shown.

### 1.2.13 Passage

Passage is defined as ingress and/or egress past an entry control device, or through a portal. Entry control procedures and equipment shall be implemented for passage through each portal as shown.

### 1.2.14 Detection Resolution

The system shall have detection resolution sufficient to locate intrusions at each device and zone; and tampering at individual devices.

### 1.2.15 Electrical Requirements

Electrically powered ESS equipment shall operate on 120 volt 60 Hz ac sources as shown. Equipment shall be able to tolerate variations in the voltage source of plus or minus 10 percent, and variations in the line frequency of plus or minus 2 percent with no degradation of performance.

### 1.2.16 Power Line Surge Protection

Equipment connected to alternating current circuits shall be protected from power line surges. Equipment protection shall withstand surge test waveforms described in IEEE C62.41. Fuses shall not be used for surge protection.

### 1.2.17 Sensor and Device Wiring and Communication Circuit Surge Protection

Inputs shall be protected against surges induced on device wiring. Outputs shall be protected against surges induced on control and device wiring installed outdoors and as shown. Communications equipment shall be protected against surges induced on any communications circuit. Cables and conductors, except fiber optics, which serve as communications circuits from console to field equipment, and between field equipment, shall have surge protection circuits installed at each end. Protection shall be furnished at equipment, and additional triple electrode gas surge protectors rated for the application on each wireline circuit shall be installed within 1 m of the building cable entrance. Fuses shall not be used for surge protection. The inputs and outputs shall be tested in both normal mode and common mode using the following two waveforms:

- a. A 10 microsecond rise time by 1000 microsecond pulse width waveform with a peak voltage of 1500 Volts and a peak current of 60 amperes.
- b. An 8 microsecond rise time by 20 microsecond pulse width waveform with a peak voltage of 1000 Volts and a peak current of 500 amperes.

#### 1.2.18 Power Line Conditioners

A power line conditioner shall be furnished for the console equipment and each local processor. The power line conditioners shall be of the ferro-resonant design, with no moving parts and no tap switching, while electrically isolating the secondary from the power line side. The power line conditioners shall be sized for 125 percent of the actual connected kVA load. Characteristics of the power line conditioners shall be as follows:

- a. At 85 percent load, the output voltage shall not deviate by more than plus or minus 1 percent of nominal when the input voltage fluctuates between minus 20 percent to plus 10 percent of nominal.
- b. During load changes of zero to full load, the output voltage shall not deviate by more than plus or minus 3 percent of nominal. Full correction of load switching disturbances shall be accomplished within 5 cycles, and 95 percent correction shall be accomplished within 2 cycles of the onset of the disturbance.
- c. Total harmonic distortion shall not exceed 3-1/2 percent at full load.

#### 1.2.19 System Reaction

##### 1.2.19.1 System Response

The field device network shall provide a system end-to-end response time of 1 second or less for every device connected to the system. Alarms shall be annunciated at the central station within 1 second of the alarm occurring at a local processor or device controlled by a local processor, and within 100 milliseconds if the alarm occurs at the central station. Alarm and status changes shall be displayed within 100 milliseconds after receipt of data by the central station. All graphics shall be displayed, including graphics generated map displays, on the console monitor within 5 seconds of alarm receipt at the security console. This response time shall be maintained during system heavy load.

##### 1.2.19.2 System Heavy Load Definition

For the purpose of system heavy load definition, the system shall consist of central station equipment, communication controller and required local processors. System heavy load conditions are defined as the occurrence of alarms at the rate of 10 alarms per second distributed evenly among all local processors in the system. The alarm printer shall continue to print out all occurrences, including time of occurrence, to the nearest second.

#### 1.2.20 Environmental Conditions

##### 1.2.20.1 Interior, Controlled Environment

System components, except the console equipment installed in interior locations, having controlled environments shall be rated for continuous operation under ambient environmental conditions of 2 to 50 degrees C dry bulb and 20 to 90 percent relative humidity, non-condensing.

##### 1.2.20.2 Interior, Uncontrolled Environment

System components installed in interior locations having uncontrolled environments shall be rated for continuous operation under ambient environmental conditions of minus 18 to plus 50 degrees C dry bulb and 10 to 95 percent relative humidity, non-condensing.

##### 1.2.20.3 Exterior Environment

System components that are installed in locations exposed to weather shall be rated for continuous operation under ambient environmental conditions of minus 34 degrees C to 50 degrees C dry bulb and 10 to 95 percent relative humidity, condensing. In addition, the system components shall be rated for continuous operation when exposed to performance conditions as specified in UL 294 and UL 639 for outdoor use equipment. Components shall be rated for continuous operation when exposed to rain as specified in NEMA 250, winds up to 137 km per hr and snow cover up to 610 mm thick, measured vertically.

##### 1.2.20.4 Console

Console equipment, unless designated otherwise, shall be rated for continuous operation under ambient environmental conditions of 16 to 29 degrees C and a relative humidity of 20 to 80 percent.

#### 1.2.21 System Capacity

### 1.3 DELIVERY OF TECHNICAL DATA AND COMPUTER SOFTWARE

All items of computer software and technical data (including technical data which relates to computer software), which is specifically identified in this specification shall be delivered in accordance with the CONTRACT CLAUSES, SPECIAL CONTRACT REQUIREMENTS, and in accordance with the Contract Data Requirements List (CDRL), DD FORM 1423, which is attached to and thereby made a part of this contract. All data delivered shall be identified by reference to the particular specification paragraph against which it is furnished.

#### 1.3.1 Group I Technical Data Package

##### 1.3.1.1 System Drawings



The data package shall include the following:

- a. System block diagram.
- b. Console installation, block diagrams, and wiring diagrams.
- c. Local processor installation, typical block, and wiring diagrams.
- d. Local processor physical layout and schematics.
- e. Device wiring and installation drawings.
- f. Details of connections to power sources, including power supplies and grounding.
- g. Details of surge protection device installation.
- h. Sensor detection patterns.
- i. Details of interconnections with CCTV system.

#### 1.3.1.2 Manufacturer's Data

The data package shall include manufacturer's data for all materials and equipment, including terminal devices, local processors and central station equipment provided under this specification.

#### 1.3.1.3 System Description and Analyses

The data package shall include system descriptions, analyses, and calculations used in sizing equipment specified. Descriptions and calculations shall show how the equipment will operate as a system to meet the performance of this specification. The data package shall include the following:

- a. Central processor memory size.
- b. Communication speeds and protocol descriptions.
- c. Hard disk size and configuration.
- d. Floppy disk size and configuration.
- e. Alarm response time calculations.
- f. Command response time calculations.
- g. Start-up operations.
- h. Expansion capability and method of implementation.
- i. Sample copy of each report specified.
- j. Color photographs representative of typical graphics.
- k. System throughput calculation.

#### 1.3.1.4 Software Data

The software data package shall consist of descriptions of the operation and capability of system, and application software as specified.

#### 1.3.1.5 Overall System Reliability Calculations

The overall system reliability calculations data package shall include all manufacturer's reliability data and calculations required to show compliance with the specified reliability in accordance with paragraph, OVERALL SYSTEM RELIABILITY REQUIREMENTS.

#### 1.3.1.6 Certifications

Specified manufacturer's certifications shall be included with the data package certification.

#### 1.3.1.7 Key Control Plan

The Contractor shall provide a key control plan. The key control plan shall include the following:

- a. Procedures that will be used to log and positively control all keys during installation.
- b. A listing of all keys and where they are used.
- c. A listing of all persons allowed access to the keys.

#### 1.3.2 Group II Technical Data Package

The Contractor shall prepare a report of "Current Site Conditions" to the Government documenting changes to the site, or conditions that affect performance of the system to be installed. The Contractor shall provide specification sheets, or written functional requirements to support the findings, and a cost estimate to correct those site changes or conditions. The Contractor shall not correct any deficiency without written permission from the Government.

#### 1.3.3 Group III Technical Data Package

The Contractor shall prepare test procedures and reports for the pre-delivery test.

#### 1.3.4 Group IV Technical Data Package

The Contractor shall prepare test procedures and reports for the performance verification test and the endurance test. The Contractor shall deliver the performance verification test and endurance test procedures to the Government for approval.

##### 1.3.4.1 Operation and Maintenance Manuals

A draft copy of the operation and maintenance manuals, as specified for the Group V technical data package, shall be delivered to the Government prior to beginning the performance verification test for use during site testing.

##### 1.3.4.2 Training Documentation

Lesson plans and training manuals for the training phases, including type of training to be provided, and a list of reference material, shall be

delivered for approval.

#### 1.3.4.3 Data Entry

The Contractor shall enter all data needed to make the system operational. The Contractor shall deliver the data to the Government on data entry forms, utilizing data from the contract documents, Contractor's field surveys, and other pertinent information in the Contractor's possession required for complete installation of the data base. The Contractor shall identify and request from the Government, any additional data needed to provide a complete and operational ESS. The completed forms shall be delivered to the Government for review and approval at least 30 days prior to the Contractor's scheduled need date.

#### 1.3.4.4 Graphics

Where graphics are required and are to be delivered with the system, the Contractor shall create and install the graphics needed to make the system operational. The Contractor shall utilize data from the contract documents, Contractor's field surveys, and other pertinent information in the Contractor's possession to complete the graphics. The Contractor shall identify and request from the Government, any additional data needed to provide a complete graphics package. Graphics shall have sufficient level of detail for the system operator to assess the alarm. The Contractor shall supply hard copy, color examples at least 200 x 250 mm in size, of each type of graphic to be used for the completed system. Also submit an AutoCADD floor plan showing the Security Zones and protected areas. The graphics examples shall be delivered to the Government for review and approval at least 30 days prior to the Contractor's scheduled need date.

#### 1.3.5 Group V Technical Data Package

Final copies of the manuals as specified, bound in hardback, loose-leaf binders, shall be delivered to the Government within 30 days after completing the endurance test. The draft copy used during site testing shall be updated with any changes required prior to final delivery of the manuals. Each manual's contents shall be identified on the cover. The manual shall include names, addresses, and telephone numbers of each subcontractor installing equipment and systems, and nearest service representative for each item of equipment. The manuals shall have a table of contents and tab sheets. Tab sheets shall be placed at the beginning of each chapter or section and at the beginning of each appendix. The final copies delivered after completion of the endurance test shall include modifications made during installation, checkout, and acceptance. The number of copies of each manual to be delivered shall be as specified on DD FORM 1423.

##### 1.3.5.1 Functional Design Manual

The functional design manual shall identify the operational requirements for the system and explain the theory of operation, design philosophy, and specific functions. A description of hardware and software functions, interfaces, and requirements shall be included for all system operating modes.

##### 1.3.5.2 Hardware Manual

A manual describing all equipment furnished including:

- a. General description and specifications.
- b. Installation and checkout procedures.
- c. Equipment electrical schematics and layout drawings.
- d. System schematics and layout drawings.
- e. Alignment and calibration procedures.
- f. Manufacturer's repair parts list indicating sources of supply.
- g. Interface definition.

#### 1.3.5.3 Software Manual

The software manual shall describe the functions of all software and shall include all other information necessary to enable proper loading, testing, and operation. The manual shall include:

- a. Definition of terms and functions.
- b. Use of system and applications software.
- c. Procedures for system initialization, start-up and shutdown.
- d. Alarm reports.
- e. Reports generation.
- f. Data base format and data entry requirements.
- g. Directory of all disk files.
- h. Description of all communication protocols, including data formats, command characters, and a sample of each type of data transfer.

#### 1.3.5.4 Operator's Manual

The operator's manual shall fully explain all procedures and instructions for the operation of the system, including:

- a. Computers and peripherals.
- b. System start-up and shutdown procedures.
- c. Use of system, and applications software.
- d. Recovery and restart procedures.
- e. Graphic alarm presentation.
- f. Use of report generator and generation of reports.
- g. Data entry.
- h. Operator commands.

- i. Alarm and system messages and printing formats.
- j. System entry requirements.

#### 1.3.5.5 Maintenance Manual

The maintenance manual shall include descriptions of maintenance for all equipment including inspection, periodic preventive maintenance, fault diagnosis, and repair or replacement of defective components.

#### 1.3.5.6 Final System Drawings

The Contractor shall maintain a separate set of drawings, elementary diagrams and wiring diagrams of the system to be used for final system drawings. This set shall be accurately kept up-to-date by the Contractor with all changes and additions to the ESS and shall be delivered to the Government with the final endurance test report. In addition to being complete and accurate, this set of drawings shall be kept neat and shall not be used for installation purposes. Final drawings submitted with the endurance test report shall be finished drawings on vellum and CD-ROM.

### 1.4 TESTING

#### 1.4.1 General

The Contractor shall perform pre-delivery testing, site testing, and adjustment of the completed ESS. The Contractor shall provide personnel, equipment, instrumentation, and supplies necessary to perform testing. Written notification of planned testing shall be given to the Government at least 14 days prior to the test; notice shall not be given until after the Contractor has received written approval of the specific test procedures.

#### 1.4.2 Test Procedures and Reports

Test procedures shall explain in detail, step-by-step actions and expected results, demonstrating compliance with the requirements specified. Test reports shall be used to document results of the tests. Reports shall be delivered to the Government within 7 days after completion of each test.

### 1.5 TRAINING

#### 1.5.1 General

The Contractor shall conduct training courses for designated personnel in the maintenance and operation of the system as specified. The training shall be oriented to the specific system being installed. Training manuals shall be delivered for each trainee with 2 additional copies delivered for archiving at the project site. The manuals shall include an agenda, defined objectives for each lesson, and a detailed description of the subject matter for each lesson. The Contractor shall furnish audio-visual equipment and other training materials and supplies. Where the Contractor presents portions of the course by audio-visual material, copies of the audio-visual material shall be delivered to the Government either as a part of the printed training manuals or on the same media as that used during the training sessions. A training day is defined as 8 hours of classroom instruction, including 2 15-minute breaks and excluding lunchtime, Monday through Friday, during the daytime shift in effect at the training facility. For guidance in planning the required instruction, the Contractor shall assume that attendees will have a high school education or

equivalent, and are familiar with ESS. Approval of the planned training schedule shall be obtained from the Government at least 30 days prior to the training.

#### 1.5.2 Operator's Training I

The first course shall be taught at the project site for a period of 5 consecutive training days at least 3 months prior to the scheduled performance verification test. A maximum of 12 personnel shall attend this course. Upon completion of this course, each student, using appropriate documentation, shall be able to perform elementary operations with guidance and describe the general hardware architecture and functionality of the system. This course shall include:

- a. General System hardware architecture.
- b. Functional operation of the system.
- c. Operator commands.
- d. Data base entry.
- e. Reports generation.
- f. Alarm reporting.
- g. Diagnostics.

#### 1.5.3 Operator's Training II

The second course shall be taught at the project site for a period of 5 consecutive training days during or after the Contractor's field testing, but before commencing the performance verification test. A maximum of 12 personnel shall attend the course. No part of the training given during this course will be counted toward completion of the performance verification test. The course shall include instruction on the specific hardware configuration of the installed system and specific instructions for operating the installed system. Upon completion of this course, each student shall be able to start the system, operate the system, recover the system after a failure, and describe the specific hardware architecture and operation of the system.

#### 1.5.4 Operator's Training III

The third course shall be taught at the project site while the endurance test is in progress for a total of 16 hours of instruction per student, in time blocks of 4 hours. A maximum of 12 personnel shall attend the course.

The schedule of instruction shall allow for each student to receive individual instruction for a 4-hour period in the morning (or afternoon) of the same weekday. The Contractor shall schedule his activities during this period so that the specified amount of time will be available during the endurance test for instructing the students. The course shall consist of hands-on training under the constant monitoring of the instructor. The instructor shall be responsible for determining the appropriate password to be issued to the student commensurate with each student's acquired skills at the beginning of each of these individual training sessions. Upon completion of this course, the students shall be fully proficient in the operation of the system.

#### 1.5.5 System Manager Training

Four system managers shall be trained at the project site for at least 3 consecutive days. The system manager training shall consist of the operator's training and the following:

- a. Enrollment/disenrollment.
- b. Assignments of identifier data.
- c. Assign operator password/levels.
- d. Change database configuration.
- e. Modify graphics.
- f. Print special or custom reports.
- g. System backup.
- h. Any other functions necessary to manage the system.

#### 1.5.6 Maintenance Personnel Training

The system maintenance course shall be taught at the project site after completion of the endurance test for a period of 5 training days. A maximum of 5 personnel, designated by the Government, will attend the course. The training shall include:

- a. Physical layout of each piece of hardware.
- b. Troubleshooting and diagnostics procedures.
- c. Repair instructions.
- d. Preventive maintenance procedures and schedules.
- e. Calibration procedures. Upon completion of this course, the students shall be fully proficient in the maintenance of the system.

### 1.6 LINE SUPERVISION

#### 1.6.1 Signal and Data Transmission System (DTS) Line Supervision

All signal and DTS lines shall be supervised by the system. The system shall supervise the signal lines by monitoring the circuit for changes or disturbances in the signal, and for conditions as described in UL 1076 for line security equipment. The system shall initiate an alarm in response to a current change of 5 percent or greater. The system shall also initiate an alarm in response to opening, closing, shorting, or grounding of the signal and DTS lines.

#### 1.6.2 Data Encryption

The system shall incorporate data encryption equipment on data transmission circuits as shown. The algorithm used for encryption shall be the Data Encryption Standard (DES) algorithm described in ANSI X3.92.

## 1.7 DATA TRANSMISSION SYSTEM

The Contractor shall provide DTS as specified in Section 16710 and as shown.

## 1.8 MAINTENANCE AND SERVICE

### 1.8.1 Warranty Period

The Contractor shall provide services required and equipment necessary to maintain the entire system in an operational state as specified, for a period of 1 year after formal written acceptance of the system, and shall provide necessary material required for performing scheduled adjustments or other nonscheduled work.

### 1.8.2 Description of Work

The adjustment and repair of the system includes all computer equipment, software updates, communications transmission equipment and DTS, local processors, sensors and entry control, facility interface, and support equipment. Responsibility shall be limited to Contractor installed equipment. The manufacturer's required adjustments and other work as necessary shall be provided.

### 1.8.3 Personnel

Service personnel shall be certified in the maintenance and repair of similar types of equipment and qualified to accomplish work promptly and satisfactorily. The Government shall be advised in writing of the name of the designated service representative, and of any change in personnel.

### 1.8.4 Schedule of Work

The Contractor shall perform 2 minor inspections at 6 month intervals (or more often if required by the manufacturer), and 2 major inspections offset equally between the minor inspections to effect quarterly inspection of alternating magnitude.

#### 1.8.4.1 Minor Inspections

Minor inspections shall include visual checks and operational tests of console equipment, peripheral equipment, local processors, sensors, and electrical and mechanical controls. Minor inspections shall also include mechanical adjustments, new ribbons, and other necessary adjustments on printers.

#### 1.8.4.2 Major Inspections

Major inspections shall include work described under paragraph Minor Inspections and the following work:

- a. Clean all system equipment and local processors, including interior and exterior surfaces.
- b. Perform diagnostics on all equipment.
- c. Check, walk test, and calibrate each sensor.
- d. Run all system software diagnostics and correct all diagnosed problems.



e. Resolve any previous outstanding problems.

f. Purge and compress data bases.

#### 1.8.4.3 Scheduled Work

Scheduled work shall be performed during regular working hours, Monday through Friday, excluding federal holidays.

#### 1.8.5 Emergency Service

The Government will initiate service calls when the system is not functioning properly. Qualified personnel shall be available to provide service to the complete system. The Government shall be furnished with a telephone number where the service supervisor can be reached at all times. Service personnel shall be at site within 2 hours after receiving a request for service during the security system warranty period. The system shall be restored to proper operating condition within 8 hours after service personnel arrive onsite.

#### 1.8.6 Operation

Performance of scheduled adjustments and repair shall verify operation of the system as demonstrated by the applicable tests of the performance verification test.

#### 1.8.7 Records and Logs

The Contractor shall keep records and logs of each task, and shall organize cumulative records for each component, and for the complete system chronologically. A continuous log shall be maintained for all devices. The log shall contain all initial settings. Complete logs shall be kept and shall be available for inspection on site, demonstrating that planned and systematic adjustments and repairs have been accomplished for the system.

#### 1.8.8 Work Requests

The Contractor shall separately record each service call request, as received. The form shall include the serial number identifying the component involved, its location, date and time the call was received, specific nature of trouble, names of service personnel assigned to the task, instructions describing what has to be done, the amount and nature of the material to be used, the time and date work started, and the time and date of completion. The Contractor shall deliver a record of the work performed within 5 days after work is accomplished.

#### 1.8.9 System Modifications

The Contractor shall make any recommendations for system modification in writing to the Government. System modifications shall not be made without prior approval of the Government. Any modifications made to the system shall be incorporated into the operation and maintenance manuals, and other documentation affected.

#### 1.8.10 Software

The Contractor shall provide a description of all software updates to the

Government, who will then decide whether or not they are appropriate for implementation. After notification by the Government, the Contractor shall implement the designated software updates and verify operation in the system. These updates shall be accomplished in a timely manner, fully coordinated with system operators, and shall be incorporated into the operation and maintenance manuals, and software documentation. There shall be at least 1 scheduled update near the end of the first year's warranty period, at which time the Contractor shall install and validate the latest released version of the Contractor's software.

## PART 2 PRODUCTS

### 2.1 MATERIALS REQUIREMENTS

#### 2.1.1 Materials and Equipment

Units of the same type of equipment shall be products of a single manufacturer. All material and equipment shall be new and currently in production. Each major component of equipment shall have the manufacturer's model and serial number in a conspicuous place. System equipment shall conform to UL 294 and UL 1076.

#### 2.1.2 Field Enclosures

##### 2.1.2.1 Interior Sensor

Sensors to be used in an interior environment shall be housed in an enclosure that provides protection against dust, falling dirt, and dripping noncorrosive liquids.

##### 2.1.2.2 Exterior Sensor

Sensors to be used in an exterior environment shall be housed in an enclosure that provides protection against windblown dust, rain and splashing water, and hose directed water. Sensors shall be undamaged by the formation of ice on the enclosure.

##### 2.1.2.3 Interior Electronics

System electronics to be used in an interior environment shall be housed in enclosures which meet the requirements of NEMA 250 Type 12.

##### 2.1.2.4 Exterior Electronics

System electronics to be used in an exterior environment shall be housed in enclosures which meet the requirements of NEMA 250 Type 4X.

#### 2.1.3 Nameplates

Laminated plastic nameplates shall be provided for local processors. Each nameplate shall identify the local processor and its location within the system. Laminated plastic shall be 3 mm thick, white with black center core. Nameplates shall be a minimum of 25 x 75 mm, with minimum 6 mm high engraved block lettering. Nameplates shall be attached to the inside of the enclosure housing the local processor. Other major components of the system shall have the manufacturer's name, address, type or style, model or serial number, and catalog number on a corrosion resistant plate secured to the item of equipment. Nameplates will not be required for devices smaller than 25 x 75 mm.

#### 2.1.4 Tamper Provisions

##### 2.1.4.1 Tamper Switches

Enclosures, cabinets, housings, boxes, and fittings having hinged doors or removable covers and which contain circuits or connections of the system and its power supplies, shall be provided with cover operated, corrosion-resistant tamper switches, arranged to initiate an alarm signal when the door or cover is moved. The enclosure and the tamper switch shall function together and shall not allow direct line of sight to any internal components before the switch activates. Tamper switches shall be inaccessible until the switch is activated; have mounting hardware concealed so that the location of the switch cannot be observed from the exterior of the enclosure; be connected to circuits which are under electrical supervision at all times, irrespective of the protection mode in which the circuit is operating; shall be spring-loaded and held in the closed position by the door or cover; and shall be wired so that they break the circuit when the door or cover is disturbed.

a. Nonsensor Enclosures: Tamper switches on nonsensor enclosures which must be opened to make routine maintenance adjustments to the system and to service the power supplies shall be push/pull-set, automatic reset type.

b. Sensor Enclosures: Tamper switches on sensor enclosures which must be opened to make routine maintenance adjustments to the sensor shall be provided.

##### 2.1.4.2 Enclosure Covers

Covers of pull and junction boxes provided to facilitate initial installation of the system need not be provided with tamper switches if they contain no splices or connections, but shall be protected by tack welding or brazing the covers in place or by tamper resistant security fasteners. Labels shall be affixed to such boxes indicating they contain no connections.

#### 2.1.5 Locks and Key-Lock Switches

##### 2.1.5.1 Locks

Locks shall be provided on system enclosures for maintenance purposes. Locks shall be UL listed, round-key type with 3 dual, 1 mushroom, 3 plain pin tumblers or conventional key type lock having a combination of 5 cylinder pin and 5-point 3 position side bar. Keys shall be stamped "U.S. GOVT. DO NOT DUP." The locks shall be arranged so that the key can only be withdrawn when in the locked position. Maintenance locks shall be keyed alike and only 2 keys shall be furnished for all of these locks. These keys shall be controlled in accordance with the key control plan as specified in paragraph Key Control Plan.

##### 2.1.5.2 Key-Lock-Operated Switches

Key-lock-operated switches required to be installed on system components shall be UL listed, round-key type, with 3 dual, 1 mushroom, and 3 plain pin tumblers or conventional key type lock having a combination of 5 cylinder pin and 5-point 3 position side bar. Keys shall be stamped "U.S. GOVT. DO NOT DUP." Key-lock-operated switches shall be 2 position, with

the key removable in either position. All key-lock-operated switches shall be keyed differently and only 2 keys shall be furnished for each key-lock-operated-switch. These keys shall be controlled in accordance with the key control plan as specified in paragraph Key Control Plan.

#### 2.1.5.3 Construction Locks

If the Contractor requires locks during installation and construction, a set of temporary locks shall be used. The final set of locks installed and delivered to the Government shall not include any of the temporary locks.

#### 2.1.6 System Components

System components shall be designed for continuous operation. Electronic components shall be solid state type, mounted on printed circuit boards conforming to UL 796. Printed circuit board connectors shall be plug-in, quick-disconnect type. Power dissipating components shall incorporate safety margins of not less than 25 percent with respect to dissipation ratings, maximum voltages, and current carrying capacity. Control relays and similar switching devices shall be solid state type or sealed electro-mechanical.

##### 2.1.6.1 Modularity

Equipment shall be designed for increase of system capability by installation of modular components. System components shall be designed to facilitate maintenance through replacement of modular subassemblies and parts.

##### 2.1.6.2 Maintainability

Components shall be designed to be maintained using commercially available tools and equipment. Components shall be arranged and assembled so they are accessible to maintenance personnel. There shall be no degradation in tamper protection, structural integrity, EMI/RFI attenuation, or line supervision after maintenance when it is performed in accordance with manufacturer's instructions. The system shall be configured and installed to yield a mean time to repair (MTTR) of not more than 8 hours. Repair time is the clock time from when maintenance personnel gain entrance to the system and begin work, until the system is fully functional.

##### 2.1.6.3 Interchangeability

The system shall be constructed with off-the-shelf components which are physically, electrically and functionally interchangeable with equivalent components as complete items. Replacement of equivalent components shall not require modification of either the new component or of other components with which the replacement items are used. Custom designed or one-of-a-kind items shall not be used. Interchangeable components or modules shall not require trial and error matching in order to meet integrated system requirements, system accuracy, or restore complete system functionality.

##### 2.1.6.4 Product Safety

System components shall conform to applicable rules and requirements of NFPA 70 and UL 294. System components shall be equipped with instruction plates including warnings and cautions describing physical safety, and special or important procedures to be followed in operating and servicing

system equipment.

#### 2.1.7 Controls and Designations

Controls and designations shall be as specified in NEMA ICS 1.

#### 2.1.8 Special Test Equipment

The Contractor shall provide all special test equipment, special hardware, software, tools, and programming or initialization equipment needed to start or maintain any part of the system and its components. Special test equipment is defined as any test equipment not normally used in an electronics maintenance facility.

#### 2.1.9 Alarm Output

The alarm output of each sensor shall be a single pole double throw (SPDT) contact rated for a minimum of 0.25 A at 24 Volts dc.

### 2.2 CENTRAL STATION HARDWARE

The central station hardware shall be an expansion of the base's existing central station. Provide all necessary hardware, equipment, cards, controllers, monitors, cables, racks, enclosures, power supplies, Uninterruptible Power Supply (UPS) backup, and other accessories necessary to provide building security systems with the functionality required. Equipment shall be mounted in racks. Update existing fixed map displays and graphics to reflect the new buildings' systems.

The existing redundant central station shall be expanded, fitted and configured the same as required for the existing central station.

The Contractor shall provide enough entry control credential cards for all personnel to be enrolled at the site plus an extra 50 percent for future use.

### 2.3 CENTRAL STATION SOFTWARE

Contractor shall provide all head end programming in the existing central station needed to expand the system to provide building security systems with the functionality required to make them fully operational and functional. This includes data entry for all parameters and constraints associated with each sensor, commandable output, zone, facility interface device, terminal device, etc. added to the system as well as making any additions or changes in the application software and system configuration files. The database shall be defined and entered into the ESS by the Contractor based upon input from the Government.

The existing redundant central station shall be expanded, fitted and configured the same as required for the existing central station.

### 2.4 FIELD PROCESSING HARDWARE

#### 2.4.1 Alarm Annunciation Local Processor

The alarm annunciation local processor shall respond to interrogations from the field device network, recognize and store alarm status inputs until they are transmitted to the central station and change outputs based on commands received from the central station. The local processor shall also

automatically restore communication within 10 seconds after an interruption with the field device network and provide dc line supervision on each of its alarm inputs.

a. Inputs. Local processor inputs shall monitor dry contacts for changes of state that reflect alarm conditions. The local processor shall have at least 8 alarm inputs which allow wiring as normally open or normally closed contacts for alarm conditions. It shall also provide line supervision for each input by monitoring each input for abnormal open, grounded, or shorted conditions using dc current change measurements. The local processor shall report line supervision alarms to the central station. Alarms shall be reported for any condition that remains off normal at an input for longer than 500 milliseconds. Each alarm condition shall be transmitted to the central computer during the next interrogation cycle.

b. Outputs. Local processor outputs shall reflect the state of commands issued by the central station. The outputs shall be a form C contact and shall include normally open and normally closed contacts. The local processor shall have at least 4 command outputs.

#### 2.4.1.1 Processor Power Supply

Local processor and sensors shall be powered from an uninterruptible power source. The uninterruptible power source shall provide 6 hours of battery back-up power in the event of primary power failure and shall automatically fully recharge the batteries within 12 hours after primary power is restored. There will be no equipment malfunctions or perturbations or loss of data during the switch from primary to battery power and vice versa. Batteries shall be sealed, non-outgassing type. The power supply shall be equipped with an indicator for ac input power and an indicator for dc output power. Loss of primary power shall be reported to the central station as an alarm.

#### 2.4.1.2 Auxiliary Equipment Power

A GFI service outlet shall be furnished inside the local processor's enclosure.

#### 2.4.2 Entry Control Local Processor

The entry control local processor shall respond to interrogations from the field device network, recognize and store alarm status inputs until they are transmitted to the central station and change outputs based on commands received from the central station. The local processor shall also automatically restore communication within 10 seconds after an interruption with the field device network and provide dc line supervision on each of its alarm inputs. The entry control local processor shall provide local entry control functions including communicating with field devices such as card readers, keypads, biometric personal identity verification devices, door strikes, magnetic latches, gate and door operators and exit pushbuttons. The processor shall also accept data from entry control field devices as well as database downloads and updates from the central station that include enrollment and privilege information. The processor shall also send indications of success or failure of attempts to use entry control field devices and make comparisons of presented information with stored identification information. The processor shall grant or deny entry by sending control signals to portal control devices and mask intrusion alarm annunciation from sensors stimulated by authorized entries. The

entry control local processor shall use inputs from entry control devices to change modes between access and secure. The local processor shall maintain a date-time and location stamped record of each transaction and transmit transaction records to the central station. The processor shall operate as a stand-alone portal controller using the downloaded data base during periods of communication loss between the local processor and the field device network. The processor shall store up to 1000 transactions during periods of communication loss between the local processor and the field device network for subsequent upload to the central station upon restoration of communication. The local processor shall provide power for field devices and portal control devices.

a. Inputs. Local processor inputs shall monitor dry contacts for changes of state that reflect alarm conditions. The local processor shall have at least 8 alarm inputs which allow wiring as normally open or normally closed contacts for alarm conditions. It shall also provide line supervision for each input by monitoring each input for abnormal open, grounded, or shorted conditions using dc current change measurements. The local processor shall report line supervision alarms to the central station. Alarms shall be reported for any condition that remains off normal at an input for longer than 500 milliseconds. Each alarm condition shall be transmitted to the central station during the next interrogation cycle. The entry control local processor shall include the necessary software drivers to communicate with entry control field devices. Information generated by the entry control field devices shall be accepted by the local processor and automatically processed to determine valid identification of the individual present at the portal. Upon authentication of the credentials or information presented, the local processor shall automatically check privileges of the identified individual, allowing only those actions granted as privileges. Privileges shall include, but not be limited to, time of day control, day of week control, group control, and visitor escort control. The local processor shall maintain a date-time and location stamped record of each transaction. A transaction is defined as any successful or unsuccessful attempt to gain access through a controlled portal by the presentation of credentials or other identifying information.

b. Outputs. Local processor outputs shall reflect the state of commands issued by the central station. The outputs shall be a form C contact and shall include normally open and normally closed contacts. The local processor shall have at least 4 commandable outputs. The entry control local processor shall also provide control outputs to portal control devices.

c. Degraded Mode of Operation. The entry control local processor shall provide a degraded mode of operation for periods when communication between the local processor and the field device network is lost. While in this degraded mode, the local processor shall continue to control entry by accepting identifying information, making authentication decisions, checking privileges, and controlling portal control devices. Transactions shall be stored for subsequent transmission to the central station when communication is restored.

#### 2.4.2.1 Processor Power Supply

Local processor and sensors shall be powered from an uninterruptible power source. The uninterruptible power source shall provide 6 hours of battery back-up power in the event of primary power failure and shall automatically fully recharge the batteries within 12 hours after primary power is

restored. There shall be no equipment malfunctions or perturbations or loss of data during the switch from primary to battery power and vice versa. Batteries shall be sealed, non-outgassing type. The power supply shall be equipped with an indicator for ac input power and an indicator for dc output power.

#### 2.4.2.2 Auxiliary Equipment Power

A ground fault interrupter (GEI) service outlet shall be furnished inside the local processor's enclosure.

### 2.5 FIELD PROCESSING SOFTWARE

All Field processing software described in this specification shall be furnished as part of the complete system.

#### 2.5.1 Operating System

Each local processor shall contain an operating system that controls and schedules that local processor's activities in real time. The local processor shall maintain a point database in its memory that includes all parameters, constraints, and the latest value or status of all points connected to that local processor. The execution of local processor application programs shall utilize the data in memory resident files. The operating system shall include a real time clock function that maintains the seconds, minutes, hours, date and month, including day of the week. Each local processor real time clock shall be automatically synchronized with the central station at least once per day to plus or minus 10 seconds. The time synchronization shall be accomplished automatically, without operator action and without requiring system shutdown.

##### 2.5.1.1 Startup

The local processor shall have startup software that causes automatic commencement of operation without human intervention, including startup of all connected Input/Output functions. A local processor restart program based on detection of power failure at the local processor shall be included in the local processor software. The startup software shall initiate operation of self-test diagnostic routines. Upon failure of the local processor, if the database and application software are no longer resident, the local processor shall not restart and systems shall remain in the failure mode indicated until the necessary repairs are made. If the database and application programs are resident, the local processor shall immediately resume operation.

##### 2.5.1.2 Operating Mode

Each local processor shall control and monitor inputs and outputs as specified, independent of communications with the central station. Alarms, status changes and other data shall be transmitted to the central station when communications circuits are operable. If communications are not available, each local processor shall function in a stand-alone mode and operational data, including the status and alarm data normally transmitted to the central station shall be stored for later transmission to the central station. Storage for the latest 1024 events shall be provided at each local processor. Each local processor shall accept software downloaded from the central station.

##### 2.5.1.3 Failure Mode



Upon failure for any reason, each local processor shall perform an orderly shutdown and force all local processor outputs to a predetermined (failure mode) state, consistent with the failure modes shown and the associated control device.

#### 2.5.2 Functions

The Contractor shall provide software necessary to accomplish the following functions, as appropriate, fully implemented and operational, within each local processor.

- a. Monitoring of inputs.
- b. Control of outputs.
- c. Reporting of alarms automatically to the central station.
- d. Reporting of sensor and output status to central station upon request.
- e. Maintenance of real time, automatically updated by the central station at least once a day.
- f. Communication with the central station.
- g. Execution of local processor resident programs.
- h. Diagnostics.
- i. Download and upload data to and from the central station.

### 2.6 INTERIOR SENSORS AND CONTROL DEVICES

#### 2.6.1 Balanced Magnetic Switch (BMS)

The BMS shall detect a 6 mm of separating relative movement between the magnet and the switch housing. Upon detecting such movement, the BMS shall transmit an alarm signal to the alarm annunciation system.

##### 2.6.1.1 BMS Subassemblies

The BMS shall consist of a switch assembly and an actuating magnet assembly. The switch mechanism shall be of the balanced magnetic type. Each switch shall be provided with an overcurrent protective device, rated to limit current to 80 percent of the switch capacity. Switches shall be rated for a minimum lifetime of 1,000,000 operations. The magnet assembly shall house the actuating magnet.

##### 2.6.1.2 Housing

The housings of surface mounted switches and magnets shall be made of nonferrous metal and shall be weatherproof. The housings of recess mounted switches and magnets shall be made of nonferrous metal or plastic.

#### 2.6.2 Duress Alarm Switches

Duress alarm switches shall provide the means for an individual to covertly notify the alarm annunciation system that a duress situation exists.

#### 2.6.2.1 Footrail

Footrail duress alarms shall be designed to be foot activated and floor mounted. No visible or audible alarm or noise shall emanate from the switch when activated. The switch housing shall shroud the activating lever to prevent accidental activation. Switches shall be rated for a minimum lifetime of 50,000 operations.

#### 2.6.2.2 Push-button

Latching push-button duress alarm switches shall be designed to be activated by depressing a push-button located on the duress switch housing. No visible or audible alarm or noise shall emanate from the switch. The switch housing shall shroud the activating button to prevent accidental activation. Switches shall be rated for a minimum lifetime of 50,000 operations.

#### 2.6.3 Passive Infrared Motion Sensor

The passive infrared motion sensor shall detect changes in the ambient level of infrared emissions caused by the movement of a standard intruder within the sensor's field of view. Upon detecting such changes, the sensor shall transmit an alarm signal to the alarm annunciation system. The sensor shall detect a change in temperature of no more than 1.1 degrees C, and shall detect a standard intruder traveling within the sensor's detection pattern at a speed of 0.09 to 2.3 m/s across 2 adjacent segments of the field of view. Emissions monitored by the sensor shall be in the 8 to 14 micron range. The sensor shall be adjustable to obtain the coverage pattern shown. The sensor shall be equipped with a temperature compensation circuit. Ceiling mounted PIR's shall incorporate mirror optional system of coverage curtains to extend coverage in 360 degrees field of view from floor to ceiling in a 1.8 mm diameter.

##### 2.6.3.1 Test Indicator, Passive Infrared

The passive infrared motion sensor shall be equipped with an LED walk test indicator. The walk test indicator shall not be visible during normal operations. When visible, the walk test indicator shall light when the sensor detects an intruder. The sensor shall either be equipped with a manual control, located within the sensor's housing, to enable/disable the test indicator or the test indicator shall be located within the sensor housing so that it can only be seen when the housing is open or removed.

##### 2.6.3.2 Remote Test, Passive Infrared

A remote test capability shall be provided. The remote test hardware may be integral to the sensor or a separate piece of equipment. The remote test shall be initiated when commanded by the alarm annunciation system. The remote test shall excite the sensing element and associated electronics causing an alarm signal to be transmitted to the alarm annunciation system. The sensor stimulation generated by the remote test hardware shall simulate a standard intruder moving within the sensor's detection pattern.

#### 2.6.4 Video Motion Sensor (Interior)

The video motion sensor shall detect changes in the video signal within a user defined detection zone. The system shall detect changes in the video signal corresponding to a standard intruder moving within the defined

detection zone and wearing clothing with a reflectivity that differs from that of the background scene by a factor of 2. All other changes in the video signal shall be rejected by the sensor. Upon detecting such changes, the sensor shall transmit an alarm signal to the alarm annunciation system.

The sensor shall include the controls and method needed by the operator to define and adjust the sensor detection zone within the video picture. The number of detection zones, the size of the detection zones, and the sensitivity of the detection zones shall be user definable. The sensor shall be a modular system that allows for expansion or modification of the number of inputs. The video inputs shall accept composite video as defined in EIA 170. Sensor controls shall be mounted on the front panel or in an adjacent rack panel. The sensor shall not require external sync for operation. One alarm output shall be provided for each video input. The number of video inputs and alarm outputs shall be as shown. All components, cables, power supplies, and other items needed for a complete video motion sensor shall be provided. Sensor equipment shall be rack mounted in a standard 19 inch rack as described in EIA ANSI/EIA-310-D. The rack shall include hardware required to mount the sensor components.

#### 2.6.5 Access/Secure Keypad

An access/secure keypad shall be used to place a protected zone in the ACCESS or SECURE mode. The keypad be housed in a NEMA 12 equivalent enclosure. The keypad shall disable zone sensor alarm outputs, but shall not disable tamper alarms, duress alarms, and other 24 hr sensors, as shown. This keypad shall be separate from the exiting card reader.

### 2.7 EXTERIOR INTRUSION SENSORS

#### 2.7.1 Video Motion Sensor (Exterior)

The video motion sensor shall detect changes in the video signal within a user defined detection zone. The system shall detect changes in the video signal corresponding to a standard intruder moving within the defined detection zone and wearing clothing with a reflectivity that differs from that of the background scene by a factor of 2. All other changes in the video signal shall be rejected by the sensor. Upon detecting such changes, the sensor shall transmit an alarm signal to the alarm annunciation system.

The sensor shall include the controls and method needed by the operator to define and adjust the sensor detection zone within the video picture. The number of detection zones, the size of the detection zones, and the sensitivity of the detection zones shall be user definable. The sensor shall be a modular system that allows for expansion or modification of the number of inputs. The video inputs shall accept composite video as defined in EIA 170. Sensor controls shall be mounted on the front panel or in an adjacent rack panel. The sensor shall not require external sync for operation. One alarm output shall be provided for each video input. The number of video inputs and alarm outputs shall be as shown. Components, cables, power supplies, and other items needed for a complete video motion sensor shall be provided. Sensor equipment shall be rack mounted in a standard 19 inch rack as described in EIA ANSI/EIA-310-D. The rack shall include hardware required to mount the sensor components.

### 2.8 ENTRY CONTROL DEVICES

#### 2.8.1 Card Readers and Credential Cards

Entry control card readers shall use unique coded data stored in or on a compatible credential card as an identifier. The card readers shall be

proximity type, and shall incorporate built-in heaters or other cold weather equipment to extend the operating temperature range as needed for operation at the site. Communications protocol shall be compatible with the local processor. The Contractor shall furnish card readers to read to match existing system entry cards, and the matching credential cards. The cards shall contain coded data arranged as a unique identification code stored on or within the card, and of the type readable by the card readers.

The Contractor shall include within the card's encoded data, a non-duplicated unique facility identification code common to all credential cards provided at the site. Enrollment equipment to support local encoding of badges including cryptographic and other internal security checks shall be supplied.

#### 2.8.1.1 Magnetic Stripe

Magnetic stripe card readers shall read credential cards which meet the requirements of ISO 7810, ISO 7811-1, ISO 7811-2, ISO 7811-3, ISO 7811-4, and ISO 7811-5. Magnetic stripe credential cards shall use single layer 4000 ersted magnetic tape material. The magnetic tape material shall be coated with Teflon and affixed to the back of the credential card near the top. The number of bits per inch, number of tracks, and number of unique codes available for the magnetic tape shall be in accordance with ISO 7811-1, ISO 7811-2, ISO 7811-3, ISO 7811-4, and ISO 7811-5.

#### 2.8.1.2 Proximity

Proximity card readers shall match existing proximity detection and shall not require contact with the proximity credential card for proper operation. The card reader shall read proximity cards in a range from 0 mm to at least 150 mm from the reader. The credential card design shall allow for a minimum of 32,000 unique identification codes per facility.

#### 2.8.1.3 Card Reader Display

The card readers shall include an LED or other visual indicator display. The display shall indicate power on/off, and whether user passage requests have been accepted or rejected.

#### 2.8.1.4 Card Reader Response Time

The card reader shall respond to passage requests by generating a signal to the local processor. The response time shall be 800 milliseconds or less, from the time the card reader finishes reading the credential card until a response signal is generated.

#### 2.8.1.5 Card Reader Power

The card reader shall be powered from the source as shown and shall not dissipate more than 5 Watts.

#### 2.8.1.6 Card Reader Mounting Method

Card readers shall be suitable for surface, semi-flush, pedestal, or weatherproof mounting as required.

#### 2.8.1.7 Credential Card Modification

Entry control cards shall be able to be modified by lamination or direct print process during the enrollment process for use as a picture and

identification badge as needed for the site without reduction of readability. The design of the credential cards shall allow for the addition of at least one slot or hole to accommodate the attachment of a clip for affixing the credential card to the type badge holder used at the site.

#### 2.8.1.8 Card Size and Dimensional Stability

Credential cards shall be 54 x 85 mm (2-1/8 x 3-3/8 inches) mm. The credential card material shall be dimensionally stable so that an undamaged card with deformations resulting from normal use shall be readable by the card reader.

#### 2.8.1.9 Card Materials and Physical Characteristics

The credential card shall be abrasion resistant, non-flammable, and present no toxic hazard to humans when used in accordance with manufacturer's instructions. The credential card shall be impervious to solar radiation and the effects of ultra-violet light.

#### 2.8.1.10 Card Construction

The credential card shall be of core and laminate or monolithic construction. Lettering, logos and other markings shall be hot stamped into the credential material or direct printed. The credential card shall incorporate holographic images or phosphorous ink as a security enhancement.

The Contractor shall provide a means to allow onsite assembly and lamination of credential cards by Government personnel.

#### 2.8.1.11 Card Durability and Maintainability

The credential cards shall be designed and constructed to yield a useful lifetime of at least 5000 insertions or swipes or 5 years whichever results in a longer period of time. The credential card shall be able to be cleaned by wiping the credential card with a sponge or cloth wet with a soap and water solution.

### 2.8.2 Keypads

Entry control keypads shall use a unique combination of alphanumeric and other symbols as an identifier. Keypads shall contain an integral alphanumeric/special symbols keyboard with symbols arranged match existing system. Communications protocol shall be compatible with the local processor.

#### 2.8.2.1 Keypad Display

Keypads shall include an LED or other type of visual indicator display and match existing system. The display shall indicate power on/off, and whether user passage requests have been accepted or rejected. The design of the keypad display or keypad enclosure shall limit the maximum horizontal and vertical viewing angles of the keypad. The maximum horizontal viewing angle shall be plus and minus 5 degrees or less off a vertical plane perpendicular to the plane of the face of the keypad display. The maximum vertical viewing angle shall be plus and minus 15 degrees or less off a horizontal plane perpendicular to the plane of the face of the keypad display.

#### 2.8.2.2 Keypad Response Time

The keypad shall respond to passage requests by generating a signal to the local processor. The response time shall be 800 milliseconds or less from the time the last alphanumeric symbol is entered until a response signal is generated.

#### 2.8.2.3 Keypad Power

The keypad shall be powered from the source as shown and shall not dissipate more than 150 Watts.

#### 2.8.2.4 Keypad Mounting Method

Keypads shall be suitable for surface, semi-flush, pedestal, or weatherproof mounting as required.

#### 2.8.2.5 Keypad Duress Codes

Keypads shall provide a means for users to indicate a duress situation by entering a special code.

### 2.8.3 Card Readers With Integral Keypad

#### 2.8.3.1 Proximity

The proximity card reader, as specified in paragraph Card Readers And Credential Cards and paragraph Proximity, shall be equipped with integral keypads as specified in paragraph Keypads.

### 2.8.4 Portal Control Devices

#### 2.8.4.1 Push-button Switches

The Contractor shall provide momentary contact, back lighted push buttons and stainless steel switch enclosures for each push button as shown. Switch enclosures shall be suitable for flush, or surface mounting as required. Push buttons shall be suitable for flush mount in the switch enclosures. The push button switches shall meet the requirements of NEMA 250 for the area in which they are to be installed. Where multiple push buttons are housed within a single switch enclosure they shall be stacked vertically with each push button switch labeled with 7 mm high text and symbols as required. The push button switches shall be connected to the local processor associated with the portal to which they are applied and shall operate the appropriate electric strike, electric bolt or other facility release device. Switches shall have a minimum continuous current rating of 10 Amperes at 120 Vac or 5 Amperes at 240 Vac. The push button switches shall have double-break silver contacts that will make 720 VA at 60 amperes and break 720 VA at 10 amperes.

#### 2.8.4.2 Panic Bar Emergency Exit With Alarm

Entry control portals shall include panic bar emergency exit hardware as shown. Panic bar emergency exit hardware shall provide local alarm annunciation and alarm communications to the portal's local processor. The panic bar shall include a conspicuous warning sign with 25 mm high, red lettering notifying personnel that an alarm will be annunciated if the panic bar is operated. Operation of the panic bar hardware shall generate an intrusion alarm. The panic bar, except for local alarm annunciation and alarm communications, shall depend upon a mechanical connection only and

shall not depend upon electric power for operation. The panic bar shall be compatible with mortise or rim mount door hardware and shall operate by retracting the bolt.

#### 2.8.4.3 Electric Door Strikes/Bolts

Electric door strikes/bolts shall be designed to release automatically in case of power failure. These facility interface devices shall use dc power to energize the solenoids. Electric strikes/bolts shall incorporate end of line resistors to facilitate line supervision by the system.

a. Solenoid: The actuating solenoid for the strikes/bolts furnished shall not dissipate more than 12 Watts and shall operate on 12 or 24 Volts dc. The inrush current shall not exceed 1 ampere and the holding current shall not be greater than 500 milliamperes. The actuating solenoid shall move from the fully secure to fully open positions in not more than 500 milliseconds.

b. Signal Switches: The strikes/bolts shall include signal switches to indicate to the system when the bolt is not engaged or the strike mechanism is unlocked. The signal switches shall report a forced entry to the system.

c. Tamper Resistance: The electric strike/bolt mechanism shall be encased in hardened guard barriers to deter forced entry.

d. Size and Weight: Electric strikes/bolts shall be compatible with standard door frame preparations.

e. Mounting Method: The electric door strikes/bolts shall be suitable for use with single and double door with mortise or rim type hardware as shown, and shall be compatible with right or left hand mounting.

#### 2.8.4.4 Electromagnetic Lock

Electromagnetic locks shall contain no moving parts and shall depend solely upon electromagnetism to secure a portal by generating at least 5.3 kN of holding force. The electromagnetic lock shall release automatically in case of power failure and shall require manual reset to resume normal function. The lock shall interface with the local processors without external, internal or functional alteration of the local processor. The electromagnetic lock shall incorporate an end of line resistor to facilitate line supervision by the system.

a. Armature: The electromagnetic lock shall contain internal circuitry to eliminate residual magnetism and inductive kickback. The actuating armature shall operate on 12 or 24 Volts dc and shall not dissipate more than 12 Watts. The holding current shall be not greater than 500 milliamperes. The actuating armature shall take not more than 300 milliseconds to change the status of the lock from fully secure to fully open or fully open to fully secure.

b. Tamper Resistance: The electromagnetic lock mechanism shall be encased in hardened guard barriers to deter forced entry.

c. Mounting Method: The door electromagnetic lock shall be suitable for use with single and double door with mortise or rim type hardware as shown, and shall be compatible with right or left hand mounting.

## 2.9 WIRE AND CABLE

The Contractor shall provide all wire and cable not indicated as Government furnished equipment. Wiring shall meet NFPA 70 standards.

### 2.9.1 Above Ground Sensor Wiring

Sensor wiring shall be 20 AWG minimum, twisted and shielded, 2, 3, 4, or 6 pairs to match hardware. Multiconductor wire shall have an outer jacket of PVC.

### 2.9.2 Local Area Network (LAN) Cabling

LAN cabling shall be in accordance with EIA ANSI/TIA/EIA-568-B, category 5.

## PART 3 EXECUTION

### 3.1 GENERAL REQUIREMENTS

The Contractor shall install all system components, including Government furnished equipment, and appurtenances in accordance with the manufacturer's instructions, IEEE C2 and as shown. The contractor shall furnish necessary interconnections, services, and adjustments required for a complete and operable system as specified and shown. Control signal, communications, and data transmission line grounding shall be installed as necessary to preclude ground loops, noise, and surges from adversely affecting system operation.

#### 3.1.1 Installation

The contractor shall install the system in accordance with the standards for safety, NFPA 70, UL 681, UL 1037 and UL 1076, and the appropriate installation manual for each equipment type. Components within the system shall be configured with appropriate service points to pinpoint system trouble in less than 20 minutes. Minimum size of conduit shall be 15 mm. DTS shall not be pulled into conduits or placed in raceways, compartments, outlet boxes, junction boxes, or similar fittings with other building wiring. Flexible cords or cord connections shall not be used to supply power to any components of the system, except where specifically noted. All other electrical work shall be as specified in Section 16415 ELECTRICAL WORK, INTERIOR and as shown.

#### 3.1.2 Enclosure Penetrations

Enclosure penetrations shall be from the bottom unless the system design requires penetrations from other directions. Penetrations of interior enclosures involving transitions of conduit from interior to exterior, and penetrations on exterior enclosures shall be sealed with rubber silicone sealant to preclude the entry of water. The conduit riser shall terminate in a hot-dipped galvanized metal cable terminator. The terminator shall be filled with an approved sealant as recommended by the cable manufacturer, and in a manner that does not damage the cable.

#### 3.1.3 Cold Galvanizing

Field welds and/or brazing on factory galvanized boxes, enclosures, conduits, etc., shall be coated with a cold galvanized paint containing at least 95 percent zinc by weight.



#### 3.1.4 Current Site Conditions

The Contractor shall verify that site conditions are in agreement with the design package. The Contractor shall report any changes in the site, or conditions that will affect performance of the system to the Government in a report as defined in paragraph Group II Technical Data Package. The Contractor shall not take any corrective action without written permission from the Government.

#### 3.1.5 Existing Equipment

The Contractor shall connect to and utilize existing equipment. System equipment and DTS that are usable in their original configuration without modification may be reused with Government approval. The Contractor shall perform a field survey, including testing and inspection of all existing system equipment and DTS intended to be incorporated into the system, and furnish a report to the Government as part of the site survey report as defined in paragraph Group II Technical Data Package. For those items considered nonfunctioning, the report shall include specification sheets, or written functional requirements to support the findings and the estimated cost to correct the deficiency. As part of the report, the Contractor shall include the scheduled need date for connection to all existing equipment. The Contractor shall make written requests and obtain approval prior to disconnecting any signal lines and equipment, and creating equipment downtime. Such work shall proceed only after receiving Government approval of these requests. If any device fails after the Contractor has commenced work on that device, signal or control line, the Contractor shall diagnose the failure and perform any necessary corrections to his equipment and work. The Government is responsible for maintenance and the repair of Government equipment. The Contractor shall be held responsible for repair costs due to Contractor negligence or abuse of Government equipment.

#### 3.1.6 Installation Software

The Contractor shall load software as specified and required for an operational system, including data bases and specified programs. Upon successful completion of the endurance test, the Contractor shall provide original and backup copies on CD-ROM of all accepted software, including diagnostics.

### 3.2 SYSTEM STARTUP

Satisfaction of the requirements below does not relieve the Contractor of responsibility for incorrect installations, defective equipment items, or collateral damage as a result of Contractor work/equipment. The Contractor shall not apply power to the system until after:

- a. System equipment items and DTS have been set up in accordance with manufacturer's instructions.
- b. A visual inspection of the system has been conducted to ensure that defective equipment items have not been installed and that there are no loose connections.
- c. System wiring has been tested and verified as correctly connected.
- d. System grounding and transient protection systems have been verified as properly installed.

e. Power supplies to be connected to the system have been verified as the correct voltage, phasing, and frequency.

### 3.3 SUPPLEMENTAL CONTRACTOR QUALITY CONTROL

The Contractor shall provide the services of technical representatives who are familiar with all components and installation procedures of the installed system; and are approved by the Contracting Officer. These representatives shall be present on the job site during the preparatory and initial phases of quality control to provide technical assistance. These representatives shall also be available on an as needed basis to provide assistance with follow-up phases of quality control. These technical representatives shall participate in the testing and validation of the system and shall provide certification that their respective system portions meet the contractual requirements.

### 3.4 TESTING

#### 3.4.1 General Requirements for Testing

The Contractor shall provide personnel, equipment, instrumentation, and supplies necessary to perform site testing. The Government will witness all performance verification and endurance testing. Written permission shall be obtained from the Government before proceeding with the next phase of testing. Original copies of all data produced during predelivery, performance verification and endurance testing, shall be turned over to the Government at the conclusion of each phase of testing, prior to Government approval of the test.

#### 3.4.2 Predelivery Testing

The Contractor shall assemble the test system as specified, and perform tests to demonstrate that performance of the system complies with specified requirements in accordance with the approved predelivery test procedures. The tests shall take place during regular daytime working hours on weekdays. Model numbers of equipment tested shall be identical to those to be delivered to the site. Original copies of all data produced during predelivery testing, including results of each test procedure, shall be delivered to the Government at the conclusion of predelivery testing, prior to Government approval of the test. The test report shall be arranged so that all commands, stimuli, and responses are correlated to allow logical interpretation.

#### 3.4.3 Test Setup

The predelivery test setup shall include the following:

- a. All central station equipment.
- b. At least 1 of each type DTS link, but not less than 2 links, and associated equipment to provide a fully integrated system.
- c. The number of local processors shall equal the amount required by the site design.
- d. At least 1 of each type sensor used.
- e. Enough sensor simulators to provide alarm signal inputs to the

system equal to the number of sensors required by the design. The alarm signals shall be manually or software generated.

f. At least 1 of each type of terminal device used.

g. Equipment as specified in Section 16751 CLOSED CIRCUIT TELEVISION SYSTEMS when required.

h. The Contractor shall prepare test procedures and reports for the predelivery test, and shall deliver the predelivery test procedures to the Government for approval. The final predelivery test report shall be delivered after completion of the predelivery test.

#### 3.4.4 Contractor's Field Testing

The Contractor shall calibrate and test all equipment, verify DTS operation, place the integrated system in service, and test the integrated system. Ground rods installed by the Contractor shall be tested as specified in IEEE Std 142. The Contractor shall deliver a report describing results of functional tests, diagnostics, and calibrations, including written certification to the Government that the installed complete system has been calibrated, tested, and is ready to begin performance verification testing. The report shall also include a copy of the approved performance verification test procedure.

#### 3.4.5 Performance Verification Test

The Contractor shall demonstrate that the completed system complies with the contract requirements. Using approved test procedures, all physical and functional requirements of the project shall be demonstrated and shown.

The performance verification test, as specified, shall not be started until after receipt by the Contractor of written permission from the Government, based on the Contractor's written report. The report shall include certification of successful completion of testing as specified in paragraph Contractor's Field Testing, and upon successful completion of training as specified. The Government may terminate testing at any time when the system fails to perform as specified. Upon termination of testing by the Government or by the Contractor, the Contractor shall commence an assessment period as described for Endurance Testing Phase II. Upon successful completion of the performance verification test, the Contractor shall deliver test reports and other documentation as specified to the Government prior to commencing the endurance test.

#### 3.4.6 Endurance Test

a. General: The Contractor shall demonstrate system reliability and operability at the specified throughput rates for each portal, and the Type I and Type II error rates specified for the completed system. The contractor shall calculate false alarm rates and the system shall yield false alarm rates within the specified maximums at the specified probability of detection. The endurance test shall be conducted in phases as specified. The endurance test shall not be started until the Government notifies the Contractor, in writing, that the performance verification test is satisfactorily completed, training as specified has been completed, and correction of all outstanding deficiencies has been satisfactorily completed. The Contractor shall provide 1 operator to operate the system 24 hours per day, including weekends and holidays, during Phase I and Phase III endurance testing, in addition to any Government personnel that may be made available. The Government may terminate testing at any time the

system fails to perform as specified. Upon termination of testing by the Government or by the Contractor, the Contractor shall commence an assessment period as described for Phase II. The Contractor shall verify the operation of each terminal device during the last day of the test. Upon successful completion of the endurance test, the Contractor shall deliver test reports and other documentation as specified to the Government prior to acceptance of the system.

b. Phase I Testing: The test shall be conducted 24 hours per day for 15 consecutive calendar days, including holidays, and the system shall operate as specified. The Contractor shall make no repairs during this phase of testing unless authorized by the Government in writing. If the system experiences no failures during Phase I testing, the Contractor may proceed directly to Phase III testing after receipt by the Contractor of written permission from the Government.

c. Phase II Assessment: After the conclusion of Phase I, the Contractor shall identify all failures, determine causes of all failures, repair all failures, and deliver a written report to the Government. The report shall explain in detail the nature of each failure, corrective action taken, results of tests performed, and shall recommend the point at which testing should be resumed. After delivering the written report, the Contractor shall convene a test review meeting at the jobsite to present the results and recommendations to the Government. The meeting shall not be scheduled earlier than 5 business days after receipt of the report by the Government. As a part of this test review meeting, the Contractor shall demonstrate that all failures have been corrected by performing appropriate portions of the performance verification test. Based on the Contractor's report and the test review meeting, the Government will determine the restart date, or may require that Phase I be repeated. If the retest is completed without any failures, the Contractor may proceed directly to Phase III testing after receipt by the Contractor of written permission from the Government.

d. Phase III Testing: The test shall be conducted 24 hours per day for 15 consecutive calendar days, including holidays, and the system shall operate as specified. The Contractor shall make no repairs during this phase of testing unless authorized by the Government in writing.

e. Phase IV Assessment: After the conclusion of Phase III, the Contractor shall identify all failures, determine causes of failures, repair failures, and deliver a written report to the Government. The report shall explain in detail the nature of each failure, corrective action taken, results of tests performed, and shall recommend the point at which testing should be resumed. After delivering the written report, the Contractor shall convene a test review meeting at the jobsite to present the results and recommendations to the Government. The meeting shall not be scheduled earlier than 5 business days after receipt of the report by the Government. As a part of this test review meeting, the Contractor shall demonstrate that all failures have been corrected by repeating appropriate portions of the performance verification test. Based on the Contractor's report and the test review meeting, the Government will determine the restart date, and may require that Phase III be repeated. The Contractor shall not commence any required retesting until after receipt of written notification by Government. After the conclusion of any retesting which the Government may require, the Phase IV assessment shall be repeated as if Phase III had just been completed.

f. Exclusions: The Contractor will not be held responsible for

failures in system performance resulting from the following:

- (1) An outage of the main power in excess of the capability of any backup power source, provided that the automatic initiation of all backup sources was accomplished and that automatic shutdown and restart of the ESS performed as specified.
- (2) Failure of a Government furnished communications circuit, provided that the failure was not due to Contractor furnished equipment, installation, or software.
- (3) Failure of existing Government owned equipment, provided that the failure was not due to Contractor furnished equipment, installation, or software.
- (4) The occurrence of specified nuisance alarms.
- (5) The occurrence of specified environmental alarms.

### 3.5 RELIABILITY CALCULATION

This exponential calculation depends on the test duration and assumes that the Mean Time Between Failures (MTBF) does not change after each repair; and that the probability of failure is constant throughout the useful life of the component regardless of how many failures the system has experienced. This calculation does not account for effects of aging.

#### 3.5.1 Definition of Reliability

System reliability is calculated in terms of overall MTBF where the component reliability furnished by vendors is already expressed as MTBF. The mathematical combination of the component MTBF values is defined as the system reliability,  $R(t)$ ; the probability that the system will perform its function during a given time period under specified conditions. In this calculation, each component reliability is determined; the component reliabilities are combined as dictated by the system configuration; and the overall MTBF is computed as follows:

$R(t) = e(-t/MTBF)$ ; where:

MTBF = mean time between failure

t = duration of test period

e = base of natural logarithms

When  $t/MTBF$  is less than 0.1, the reliability can be approximated as follows:

$R(t) = 1 - (t/MTBF)$ : A specific reliability value can be interpreted by noting that a value of  $R(t)$  greater than  $1/e$  (which equals 0.37) indicates that the MTBF value is greater than the test duration.

#### 3.5.2 Series and Parallel Components

Components are in series if failure of 1 component causes a system failure. Reliability of components in series is a product of the individual reliabilities:

$R = 1 - (r_1)(r_2)(r_3)...(r_n)$ . If components in a system are redundant (parallel), reliability is computed as follows:

$R = 1 - \{(1-r_1)(1-r_2)...(1-r_n)\}$ . If a system has parallel components, an equivalent series reliability is computed for each set of parallel components. The reliability of the system is then computed as the product of series and equivalent series reliabilities.

### 3.5.3 Calculation Procedure

The Contractor shall prepare a table showing the following data:

- a. Name and quantity of each component.
- b. Each component identified as series or parallel. (For example, if there are 2 printers, the failure of 1 will not cause a system failure).
- c. MTBF for each component.
- d. Single unit reliability:  $R = e(-t/MTBF)$ , where  $t = 1,000$  hour test period.
- e. Total Component Reliability (TCR) where  $TCR = R^n$ , and  $n =$  number of components. For parallel components,  $TCR = 1 - (1-R)^n$ , where  $n =$  number of components.
- f. Cumulative Reliability (CUMR) is the product of total component reliability; for example:  $CUMR_4 = (TCR_1)(TCR_2)(TCR_3)(TCR_4) = (CUMR_3)(TCR_4)$
- g. Cumulative MTBF =  $-1,000/LN(CUMR)$ ; where  $LN(CUMR)$  is the natural logarithm of (CUMR). As an example:  $CUM.MTBF = -1,000/LN(CUMR_4)$

### 3.5.4 Sample Calculations

MTBF is not calculated for sensors and controls. Input/Output functions are part of the local processor. Any Input/Output failure not attributable to sensors and controls constitutes a local processor failure and is thus reflected in the local processor MTBF. MTBF for other components are based on the lowest values provided by vendors. The calculation shall be based on the following configuration:

- a. All central station equipment.
- b. Data Transmission System (DTS) equipment associated with one DTS circuit, but excluding the circuit itself.
- c. Sixteen local processors with all the functions as specified in paragraph Local Processor.
- d. Four representative types of devices, per local processor.

-- End of Section --

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## DIVISION 13 - SPECIAL CONSTRUCTION

## SECTION 13851

## FIRE DETECTION AND ALARM SYSTEM, ADDRESSABLE

02/02

## PART 1 GENERAL

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## SECTION 13851

FIRE DETECTION AND ALARM SYSTEM, ADDRESSABLE  
**02/02**

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI S3.41 (1990; R 1996) Audible Emergency  
Evacuation Signal

## INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C62.41 (1991; R 1995) Surge Voltages in  
Low-Voltage AC Power Circuits

## NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (2002) National Electrical Code

NFPA 72 (2002) National Fire Alarm Code

NFPA 90A (2002) Installation of Air Conditioning  
and Ventilating Systems

## UNDERWRITERS LABORATORIES (UL)

UL 1242 (1996; Rev Mar 1998) Intermediate Metal  
Conduit

UL 1971 (1995; Rev thru Apr 1999) Signaling  
Devices for the Hearing Impaired

UL 228 (1997; Rev Jan 1999) Door Closers-Holders,  
With or Without Integral Smoke Detectors

UL 268 (1996; Rev thru Jan 1999) Smoke Detectors  
for Fire Protective Signaling Systems

UL 268A (1998) Smoke Detectors for Duct Application

UL 38 (1999) Manually Actuated Signaling Boxes  
for Use with Fire-Protective Signaling  
Systems

UL 464 (1996; Rev thru May 1999) Audible Signal  
Appliances

UL 521 (1999) Heat Detectors for Fire Protective

## Signaling Systems

UL 6	(1997) Rigid Metal Conduit
UL 797	(1993; Rev thru Mar 1997) Electrical Metallic Tubing
UL 864	(1996; Rev thru Mar 1999) Control Units for Fire Protective Signaling Systems

## 1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

## SD-02 Shop Drawings

Fire Alarm Reporting System; G, AO.

Detail drawings, prepared and signed by a Registered Professional Engineer or a NICET Level 4 Fire Alarm Technician, consisting of a complete list of equipment and material, including manufacturer's descriptive and technical literature, catalog cuts, and installation instructions. Note that the contract drawings show layouts based on typical detectors. The Contractor shall check the layout based on the actual detectors to be installed and make any necessary revisions in the detail drawings. The detail drawings shall also contain complete wiring and schematic diagrams for the equipment furnished, equipment layout, and any other details required to demonstrate that the system has been coordinated and will properly function as a unit. Detailed point-to-point wiring diagram shall be prepared and signed by a Registered Professional Engineer or a NICET Level 4 Fire Alarm Technician showing points of connection. Diagram shall include connections between system devices, appliances, control panels, supervised devices, and equipment that is activated or controlled by the panel.

## SD-03 Product Data

Storage Batteries; G, AO.

Substantiating battery calculations for supervisory and alarm power requirements. Ampere-hour requirements for each system component and each panel component, and the battery recharging period shall be included.

Voltage Drop; G, AO.

Voltage drop calculations for notification appliance circuits to indicate that sufficient voltage is available for proper appliance operation.

Special Tools and Spare Parts; G, AO.

Spare parts data for each different item of material and equipment specified, not later than 3 months prior to the date of beneficial occupancy. Data shall include a complete list of parts and supplies with the current unit prices and source of supply and a list of the parts recommended by the manufacturer to be replaced after 1 year of service.

Technical Data and Computer Software; G, AO.

Technical data which relates to computer software.

Training; G, AO.

Lesson plans, operating instructions, maintenance procedures, and training data, furnished in manual format, for the training courses. The operations training shall familiarize designated government personnel with proper operation of the fire alarm system. The maintenance training course shall provide the designated government personnel adequate knowledge required to diagnose, repair, maintain, and expand functions inherent to the system.

Testing; G, AO.

Detailed test procedures, prepared and signed by a Registered Professional Engineer or a NICET Level 4 Fire Alarm Technician, for the fire detection and alarm system 60 days prior to performing system tests.

#### SD-06 Test Reports

Testing; G, AO.

Test reports, in booklet form, showing field tests performed to prove compliance with the specified performance criteria, upon completion and testing of the installed system. Each test report shall document readings, test results and indicate the final position of controls. The Contractor shall include the NFPA 72 Certificate of Completion and NFPA 72 Inspection and Testing Form, with the appropriate test reports.

#### SD-07 Certificates

Equipment.

Certified copies of current approvals or listings issued by an independent test lab if not listed by UL, FM or other nationally recognized testing laboratory, showing compliance with specified NFPA standards.

Qualifications.

Proof of qualifications for required personnel. The installer shall submit proof of experience for the Professional Engineer, fire alarm technician, and the installing company.

#### SD-10 Operation and Maintenance Data

Technical Data and Computer Software; G, AO.

Six copies of operating manual outlining step-by-step procedures required for system startup, operation, and shutdown. The manual shall include the manufacturer's name, model number, service manual, parts list, and complete description of equipment and their basic operating features. Six copies of maintenance manual listing routine maintenance procedures, possible breakdowns and repairs, and troubleshooting guide. The manuals shall include conduit layout, equipment layout and simplified wiring, and control diagrams of the system as installed. The manuals shall include complete procedures for system revision and expansion, detailing both equipment and software requirements. Original and backup copies of all software delivered for this project shall be provided, on each type of media utilized. Manuals shall be approved prior to training.

### 1.3 GENERAL REQUIREMENTS

#### 1.3.1 ADDRESSABLE FIRE DETECTION AND ALARM SYSTEM

Notwithstanding Section 00700 CONTRACT CLAUSES FAR 52.236-5, Material and Workmanship, the Addressable Fire Detection and Alarm System Style IRC-3 shall be manufactured by Edwards Systems Technology in order to be fully compatible with and interface with the existing Base fire alarm system. No other product will be acceptable. The Competition Advocate authorizes sole source procurement.

#### 1.3.2 Standard Products

Material and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products for at least 2 years prior to bid opening. Equipment shall be supported by a service organization that can provide service within 24 hours of notification.

#### 1.3.3 Nameplates

Major components of equipment shall have the manufacturer's name, address, type or style, voltage and current rating, and catalog number on a noncorrosive and nonheat-sensitive plate which is securely attached to the equipment.

#### 1.3.4 Keys and Locks

Locks shall be keyed alike. Keys shall match existing system.

#### 1.3.5 Tags

Tags with stamped identification number shall be furnished for keys and locks.

#### 1.3.6 Verification of Dimensions

After becoming familiar with details of the work, the Contractor shall verify dimensions in the field and shall advise the Contracting Officer of any discrepancy before performing the work.

#### 1.3.7 Compliance

The fire detection and alarm system and the central reporting system shall

be configured in accordance with NFPA 72; exceptions are acceptable as directed by the Contracting Officer. The equipment furnished shall be compatible and be UL listed, FM approved, or approved or listed by a nationally recognized testing laboratory in accordance with the applicable NFPA standards.

#### 1.3.8 Qualifications

##### 1.3.8.1 Engineer and Technician

a. Registered Professional Engineer with verification of experience and at least 4 years of current experience in the design of the fire protection and detection systems.

b. National Institute for Certification in Engineering Technologies (NICET) qualifications as an engineering technician in fire alarm systems program with verification of experience and current NICET certificate.

c. The Registered Professional Engineer may perform all required items under this specification. The NICET Fire Alarm Technician shall perform only the items allowed by the specific category of certification held.

##### 1.3.8.2 Installer

The installing Contractor shall provide the following: NICET Fire Alarm Technicians to perform the installation of the system. A NICET Level 4 Fire Alarm Technician shall supervise the installation of the fire alarm system. NICET Level 2 or higher Fire Alarm Technician shall install and terminate fire alarm devices, cabinets and panels. An electrician or NICET Level 1 Fire Alarm Technician shall install conduit for the fire alarm system. The Fire Alarm technicians installing the equipment shall be factory trained in the installation, adjustment, testing, and operation of the equipment specified herein and on the drawings.

##### 1.3.8.3 Design Services

Installations requiring designs or modifications of fire detection, fire alarm, or fire suppression systems shall require the services and review of a qualified fire protection engineer. For the purposes of meeting this requirement, a qualified fire protection engineer is defined as an individual meeting one of the following conditions:

- a. An engineer having a Bachelor of Science or Masters of Science Degree in Fire Protection Engineering from an accredited university engineering program, plus a minimum of 2 years' work experience in fire protection engineering.
- b. A registered professional engineer (P.E.) in fire protection engineering.
- c. A registered PE in a related engineering discipline and member grade status in the National Society of Fire Protection Engineers.
- d. An engineer with a minimum of 10 years' experience in fire protection engineering and member grade status in the National Society of Fire Protection Engineers.

#### 1.4 SYSTEM DESIGN

#### 1.4.1 Operation

The fire alarm and detection system shall be a complete, supervised fire alarm reporting system and bomb alarm system implemented through the fire alarm control panel. The fire alarm system shall be activated into the alarm mode by actuation of any fire alarm initiating device. The system shall remain in the alarm mode until the initiating device is reset and the fire alarm portion of the control panel is reset and restored to normal. The bomb alarm system shall be activated into the alarm mode by activation of any bomb alarm initiating device. The bomb alarm system shall be activated into the alarm mode by activation of any bomb alarm initiating device. Alarm initiating devices shall be connected to signal line circuits (SLC), Style 6, in accordance with NFPA 72. Alarm notification appliances shall be connected to notification appliance circuits (NAC), Style Z in accordance with NFPA 72. A looped conduit system shall be provided so that if the conduit and all conductors within are severed at any point, all IDC, NAC and SLC will remain functional. The conduit loop requirement is not applicable to the signal transmission link from the local panels (at the protected premises) to the Supervising Station (fire station, fire alarm central communication center). Textual, audible, and visual appliances and systems shall comply with NFPA 72. Fire alarm system components requiring power, except for the control panel power supply, shall operate on 24 Volts dc. Addressable system shall be microcomputer (microprocessor or microcontroller) based with a minimum word size of eight bits and shall provide the following features:

- a. Sufficient memory to perform as specified and as shown for addressable system.
- b. Individual identity of each addressable device for the following conditions: alarm; trouble; open; short; and appliances missing/failed remote detector - sensitivity adjustment from the panel for smoke detectors
- c. Capability of each addressable device being individually disabled or enabled from the panel.
- d. Each SLC shall be sized to provide 40 percent addressable expansion without hardware modifications to the panel.

#### 1.4.2 Operational Features

The system shall have the following operating features:

- a. Monitor electrical supervision of IDC, SLC, and NAC.
- b. Monitor electrical supervision of the primary power (ac) supply, battery voltage, placement of alarm zone module (card, PC board) within the control panel, and transmitter tripping circuit integrity.
- c. A trouble buzzer and trouble LED/LCD (light emitting diode/liquid crystal diode) to activate upon a single break, open, or ground fault condition which prevents the required normal operation of the system. The trouble signal shall also operate upon loss of primary power (ac) supply, low battery voltage, removal of alarm zone module (card, PC board), and disconnection of the circuit used for transmitting alarm signals off-premises. A trouble alarm

silence switch shall be provided which will silence the trouble buzzer, but will not extinguish the trouble indicator LED/LCD. Subsequent trouble and supervisory alarms shall sound the trouble signal until silenced. After the system returns to normal operating conditions, the trouble buzzer shall again sound until the silencing switch returns to normal position, unless automatic trouble reset is provided.

- d. A one person test mode. Activating an initiating device in this mode will activate an alarm for a short period of time, then automatically reset the alarm, without activating the transmitter during the entire process.
- e. A transmitter disconnect switch to allow testing and maintenance of the system without activating the transmitter but providing a trouble signal when disconnected and a restoration signal when reconnected.
- f. Evacuation alarm silencing switch which, when activated, will silence alarm devices, but will not affect the zone indicating LED/LCD nor the operation of the transmitter. This switch shall be over-ridden upon activation of a subsequent alarm from an unalarmed device and the NAC devices will be activated.
- g. Electrical supervision for circuits used for supervisory signal services (i.e., sprinkler systems, valves, etc.). Supervision shall detect any open, short, or ground.
- h. Confirmation or verification of all smoke detectors. The control panel shall interrupt the transmission of an alarm signal to the system control panel for a factory preset period. This interruption period shall be adjustable from 1 to 60 seconds and be factory set at 20 seconds. Immediately following the interruption period, a confirmation period shall be in effect during which time an alarm signal, if present, will be sent immediately to the control panel. Fire alarm devices other than smoke detectors shall be programmed without confirmation or verification.
- i. The fire alarm control panel shall provide supervised addressable relays for HVAC shutdown. An override at the HVAC panel shall not be provided. An override at the HVAC panel shall not be provided. A key operated by-pass switch shall be installed on the main fire alarm control panel that will allow the air handling units to be restarted while the duct smoke detectors are in an alarm condition. After the duct smoke detectors have been reset to normal operation, the Fire Alarm Control Panel shall indicate a trouble condition until the by-pass switch is returned to the normal or non-by-pass position.
- j. Provide one person test mode - Activating an initiating device in this mode will activate an alarm for a short period of time, then automatically reset the alarm, without activating the transmitter during the entire process.
- k. The fire alarm control panel shall provide the required monitoring and supervised control outputs needed to accomplish elevator recall.

- l. The fire alarm control panel shall monitor the fire sprinkler system, or other fire protection extinguishing system.
- m. The control panel and field panels shall be software reprogrammable to enable expansion or modification of the system without replacement of hardware or firmware. Examples of required changes are: adding or deleting devices or zones; changing system responses to particular input signals; programming certain input signals to activate auxiliary devices.
- n. Zones for NAC shall be arranged as approved by the Contracting Officer.

#### 1.4.3 Alarm Functions

An alarm condition on a circuit shall automatically initiate the following functions:

- a. Transmission of signals over the station telephonic fire reporting system. The signal shall be different each scheduled zone. The address of a device which is in alarm or trouble state shall be transmitted to the fire department.
- b. Visual indications of the alarmed devices on the fire alarm control panel display and on the remote audible/visual display.
- c. Continuous sounding or operation of alarm notification appliances only in designated areas as required by ANSI S3.41.
- d. Closure of doors held open by electromagnetic devices.
- e. Operation of the smoke control system.
- f. Deactivation of the air handling units serving the alarmed area.
- g. Shutdown of power to the data processing equipment in the alarmed area.
- h. Functions indicated on the "Secured of Operations Matrix".

#### 1.4.4 Primary Power

Operating power shall be provided as required by paragraph Power Supply for the System. Transfer from normal to emergency power or restoration from emergency to normal power shall be fully automatic and not cause transmission of a false alarm. Loss of ac power shall not prevent transmission of a signal via the fire reporting system upon operation of any initiating circuit.

#### 1.4.5 Battery Backup Power

Battery backup power shall be through use of rechargeable, sealed-type storage batteries and battery charger.

#### 1.4.6 Interface With Existing Fire Alarm Equipment

The equipment specified herein shall be compatible with the existing fireworks central fire alarm reporting system. New components shall be capable of merging with the existing configuration without degrading the



performance of either system. The scope of the acceptance tests of paragraph Testing shall include aspects of operation that involve combined use of both new and existing portions of the final configuration.

#### 1.4.7 Interface With other Equipment

Interfacing components shall be furnished as required to connect to subsystems or devices which interact with the fire alarm system, such as supervisory or alarm contacts in suppression systems, operating interfaces for smoke control systems, door releases, etc.

#### 1.4.8 Isolation of Emergency Notification Systems

Requirements for notification systems are specified in Section 01011 FORCE PROTECTION AND SECURITY REQUIREMENTS.

### 1.5 TECHNICAL DATA AND COMPUTER SOFTWARE

Technical data and computer software (meaning technical data which relates to computer software) which is specifically identified in this project, and which may be defined/required in other specifications, shall be delivered, strictly in accordance with the CONTRACT CLAUSES, and in accordance with the Contract Data Requirements List, DD Form 1423. Data delivered shall be identified by reference to the particular specification paragraph against which it is furnished. Data to be submitted shall include complete system, equipment, and software descriptions. Descriptions shall show how the equipment will operate as a system to meet the performance requirements of this contract. The data package shall also include the following:

- (1) Identification of programmable portions of system equipment and capabilities.
- (2) Description of system revision and expansion capabilities and methods of implementation detailing both equipment and software requirements.
- (3) Provision of operational software data on all modes of programmable portions of the fire alarm and detection system.
- (4) Description of Fire Alarm Control Panel equipment operation.
- (5) Description of auxiliary and remote equipment operations.
- (6) Library of application software.
- (7) Operation and maintenance manuals as specified in SD-19 of the Submittals paragraph.

### 1.6 DELIVERY AND STORAGE

Equipment delivered and placed in storage shall be stored with protection from the weather, humidity and temperature variation, dirt, dust, and any other contaminants.

## PART 2 PRODUCTS

### 2.1 CONTROL PANEL

Control Panel shall comply with the applicable requirements of UL 864.

Panel shall be modular, installed in a surface mounted steel cabinet with hinged door and cylinder lock. Control panel shall be a clean, uncluttered, and orderly assembled panel containing components and equipment required to provide the specified operating and supervisory functions of the system. The panel shall have prominent rigid plastic, phenolic or metal identification plates for LED/LCDs, zones, SLC, controls, meters, fuses, and switches. Nameplates for fuses shall also include ampere rating. The LED/LCD displays shall be located on the exterior of the cabinet door or be visible through the cabinet door. Control panel switches shall be within the locked cabinet. A suitable means (single operation) shall be provided for testing the control panel visual indicating devices (meters or LEDs/LCDs). Meters and LEDs shall be plainly visible when the cabinet door is closed. Signals and LEDs/LCDs shall be provided to indicate by zone any alarm, supervisory or trouble condition on the system. Loss of power, including batteries, shall not require the manual reloading of a program. Upon restoration of power, startup shall be automatic, and shall not require any manual operation. The loss of primary power or the sequence of applying primary or emergency power shall not affect the transmission of alarm, supervisory or trouble signals. Visual annunciation shall be provided for LED/LCD visual display as an integral part of the control panel and shall identify with a word description and id number each device. Cabinets shall be provided with ample gutter space to allow proper clearance between the cabinet and live parts of the panel equipment. If more than one modular unit is required to form a control panel, the units shall be installed in a single cabinet large enough to accommodate units. Cabinets shall be factory finished as required in Section 09915. Remove and replace existing Kirland graphic annunciator as required to expand visual graphic display.

#### 2.1.1 Remote System Audible/Visual Display

Audible appliance shall have a minimum sound level output rating of 85 dBA at 3.05 m and operate in conjunction with the panel integral display. The audible device shall be silenced by a system silence switch on the remote system. The audible device shall be silenced by the system silence switch located at the remote location, but shall not extinguish the visual indication. The remote LED/LCD visual display shall provide identification, consisting of the word description and id number for each device as displayed on the control panel. A rigid plastic, phenolic or metal identification sign which reads "Fire Alarm System Remote Display" shall be provided at the remote audible/visual display. The remote visual appliance located with the audible appliance shall not be extinguished until the trouble or alarm has been cleared.

#### 2.1.2 Circuit Connections

Circuit conductors entering or leaving the panel shall be connected to screw-type terminals with each conductor and terminal marked for identification.

#### 2.1.3 System Expansion and Modification Capabilities

Any equipment and software needed by qualified technicians to implement future changes to the fire alarm system shall be provided as part of this contract.

#### 2.1.4 Addressable Control Module

The control module shall be capable of operating as a relay (dry contact

form C) for interfacing the control panel with other systems, and to control door holders or initiate elevator fire service. The module shall be UL listed as compatible with the control panel. The indicating device or the external load being controlled shall be configured as a Style Y notification appliance circuits. The system shall be capable of supervising, audible, visual and dry contact circuits. The control module shall have both an input and output address. The supervision shall detect a short on the supervised circuit and shall prevent power from being applied to the circuit. The control model shall provide address setting means compatible with the control panel's SLC supervision and store an internal identifying code. The control module shall contain an integral LED that flashes each time the control module is polled.

#### 2.1.5 Addressable Initiating Device Circuits Module

The initiating device being monitored shall be configured as a Style D initiating device circuits. The system shall be capable of defining any module as an alarm module and report alarm trouble, loss of polling, or as a supervisory module, and reporting supervisory short, supervisory open or loss of polling. The module shall be UL listed as compatible with the control panel. The monitor module shall provide address setting means compatible with the control panel's SLC supervision and store an internal identifying code. Monitor module shall contain an integral LED that flashes each time the monitor module is polled. Pull stations with a monitor module in a common backbox are not required to have an LED.

#### 2.2 STORAGE BATTERIES

Storage batteries shall be provided and shall be 24 Vdc sealed, lead-calcium type requiring no additional water. The batteries shall have ample capacity, with primary power disconnected, to operate the fire alarm system for a period of 72 hours. Following this period of battery operation, the batteries shall have ample capacity to operate all components of the system, including all alarm signaling devices in the total alarm mode for a minimum period of 15 minutes. Batteries shall be located at the bottom of the panel. Batteries shall be provided with overcurrent protection in accordance with NFPA 72. Separate battery cabinets shall have a lockable, hinged cover similar to the fire alarm panel. The lock shall be keyed the same as the fire alarm control panel. Cabinets shall be painted to match the fire alarm control panel.

#### 2.3 BATTERY CHARGER

Battery charger shall be completely automatic, 24 Vdc with high/low charging rate, capable of restoring the batteries from full discharge (18 Volts dc) to full charge within 48 hours. A pilot light indicating when batteries are manually placed on a high rate of charge shall be provided as part of the unit assembly, if a high rate switch is provided. Charger shall be located in control panel cabinet or in a separate battery cabinet.

#### 2.4 ADDRESSABLE MANUAL FIRE ALARM STATIONS

Addressable manual fire alarm stations shall conform to the applicable requirements of UL 38. Manual stations shall be connected into signal line circuits. Stations shall be installed on semi-flush mounted outlet boxes. Manual stations shall be mounted at 1219 mm. Stations shall be single action type. Stations shall be finished in red, with raised letter operating instructions of contrasting color. Stations requiring the breaking of glass or plastic panels for operation are not acceptable.

Stations employing glass rods are not acceptable. The use of a key be required to reset the station. Gravity or mercury switches are not acceptable. Switches and contacts shall be rated for the voltage and current upon which they operate. Addressable pull stations shall be capable of being field programmed, shall latch upon operation and remain latched until manually reset. Stations shall have a separate screw terminal for each conductor. Surface mounted boxes shall be matched and painted the same color as the fire alarm manual stations. Stations shall be labeled with device ID number and corresponding NAC zone number.

## 2.5 FIRE DETECTING DEVICES

Fire detecting devices shall comply with the applicable requirements of NFPA 72, NFPA 90A, UL 268, UL 268A, and UL 521. The detectors shall be provided as indicated. Detector base shall have screw terminals for making connections. No solder connections will be allowed. Detectors located in concealed locations (above ceiling, raised floors, etc.) shall have a remote visible indicator LED/LCD. Addressable fire detecting devices, except flame detectors, shall be dynamically supervised and uniquely identified in the control panel. All fire alarm initiating devices shall be individually addressable, except where indicated.

### 2.5.1 Heat Detectors

Heat detectors shall be designed for detection of fire by combination fixed temperature and rate-of-rise principle. Heat detector spacing shall be rated in accordance with UL 521. Detectors located in areas subject to moisture, exterior atmospheric conditions, or hazardous locations as defined by NFPA 70 and as shown on drawings, shall be types approved for such locations. Heat detectors located in attic spaces or similar concealed spaces below the roof shall be intermediate temperature rated.

#### 2.5.1.1 Combination Fixed-Temperature and Rate-of-Rise Detectors

Detectors shall be designed for surface outlet box mounting and supported independently of wiring connections. Contacts shall be self-resetting after response to rate-of-rise principle. Under fixed temperature actuation, the detector shall have a permanent external indication which is readily visible. Detector units located in boiler rooms, showers, or other areas subject to abnormal temperature changes shall operate on fixed temperature principle only. The UL 521 test rating for the fixed temperature portion shall be 57.2 degrees C. The UL 521 test rating for the Rate-of-Rise detectors shall be rated for 15 by 15 m.

### 2.5.2 Smoke Detectors

Smoke detectors shall be designed for detection of abnormal smoke densities. Smoke detectors shall be photoelectric type. Detectors shall contain a visible indicator LED/LCD that shows when the unit is in alarm condition. Detectors shall not be adversely affected by vibration or pressure. Detectors shall be the plug-in type in which the detector base contains terminals for making wiring connections. Detectors that are to be installed in concealed (above false ceilings, etc.) locations shall be provided with a remote indicator LED/LCD suitable for mounting in a finished, visible location.

#### 2.5.2.1 Photoelectric Detectors

Detectors shall operate on a light scattering concept using an LED light

source. Failure of the LED shall not cause an alarm condition. Detectors shall be factory set for sensitivity and shall require no field adjustments of any kind. Detectors shall have an obscuration rating in accordance with UL 268. Addressable smoke detectors shall be capable of having the sensitivity being remotely adjusted by the control panel.

#### 2.5.2.2 Projected Beam Smoke Detectors

Detectors shall be designed for detection of abnormal smoke densities. Detectors shall consist of separate transmitter and receiver units. The transmitter unit shall emit an infrared beam to the receiver unit. When the signal at the receiver falls below a preset sensitivity, the detector shall initiate an alarm. The receiver shall contain an LED which is powered upon an alarm condition. Long-term changes to the received signal caused by environmental variations shall be automatically compensated. Detectors shall incorporate features to assure that they are operational; a trouble signal shall be initiated if the beam is obstructed, the limits of the compensation circuit are reached, or the housing cover is removed. Detectors shall have multiple sensitivity settings in order to meet UL listings for the different distances covered by the beam. In the event of beam interference for more than three seconds a trouble alarm shall be transmitted.

#### 2.5.2.3 Duct Detectors

Duct-mounted photoelectric smoke detectors shall be furnished and installed where indicated and in accordance with NFPA 90A. Units shall consist of a smoke detector as specified in paragraph Photoelectric Detectors, mounted in a special housing fitted with duct sampling tubes. Detector circuitry shall be mounted in a metallic enclosure exterior to the duct. Detectors shall have a manual reset. Detectors shall be rated for air velocities that include air flows between 2.5 and 20 m/s. Detectors shall be powered from the fire alarm panel. Sampling tubes shall run the full width of the duct. The duct detector package shall conform to the requirements of NFPA 90A, UL 268A, and shall be UL listed for use in air-handling systems. The control functions, operation, reset, and bypass shall be controlled from the fire alarm control panel. Lights to indicate the operation and alarm condition; and the test and reset buttons shall be visible and accessible with the unit installed and the cover in place. Detectors mounted above 1.83 m and those mounted below 1.83 m that cannot be easily accessed while standing on the floor, shall be provided with a remote detector indicator panel containing test and reset switches. Remote lamps and switches as well as the affected fan units shall be properly identified in etched plastic placards. Detectors shall have auxiliary contacts to provide control, interlock, and shutdown functions specified in Section 15950A HEATING, VENTILATING AND AIR CONDITIONING (HVAC) CONTROL SYSTEMS. The detectors shall be supplied by the fire alarm system manufacturer to ensure complete system compatibility.

#### 2.5.3 Air Sampling Smoke Detectors

Air sampling type detector system of components shall consist of a highly sensitive triple integrating nephelometer type smoke detector, aspirating fan, controller and filter if required with a fail safe selector valve mechanism. The system shall utilize the principle of sampling all the sectors simultaneously. When a pre-programmed level of smoke is detected, an automatic sequence shall be initiated to sample each sector individually. If an alarm level is attained, the unit shall continue its sequence mode until the smoke level signal reduces below the scan level.

The system shall be self-contained, to include; a control system utilizing microprocessor based technology with all functions fully programmable; LED indications, airflow and detector fault; smoke alarm and outputs for remote selector valve functions. The system shall include an air sampling pipe network to transport air from each sector to the detection system and shall interface with building fire alarm system, and signaling module. The system shall be UL 268 listed for special applications. See attached product cutsheets for submittal.

#### 2.5.3.1 Performance Requirements

The system shall be tested to cover a cumulative area up to 1860 Sq. M with a (maximum of 4 sectors, 465 Sq. M each. Provide very early smoke alert, action and fire levels for each sector, and report any fault on the unit by a general fault output relay.

#### 2.5.3.2 Components

##### Smoke Detector Assembly

- a. The detector, filter, (if required) selector valve mechanism and aspirating fan shall be housed in an enclosure and shall be arranged in such a way that air is drawn from the protected sectors through the filter if required and valve assembly and detector by the aspirating fan.
- b. The detector shall be of the triple integrating nephelometer type and shall have a nominal obscuration level ranges .003-.03%/ft. (0.005-20% obscuration/M).
- c. The detector shall also incorporate facilities to transmit detector fault and air flow fault conditions.
- d. The detector shall also incorporate the selector valve mechanism and have one of the following filters (if required):
  1. Removable and washable, high efficiency, three stage foam type.
  2. Modular and replaceable, high efficiency, paper element cartridge.
  3. Modular and replaceable, high efficiency, synthetic element cartridge type.
- e. The selector valve shall be built into the filter (if required) assembly with fail safe to ensure uninterrupted protection, and begin to sample each pipe individually upon detection of a pre-programmed level of smoke to localize the fire source (sector), and operate once the preprogrammed scan level is reached or upon manual activation of the scan button.
- f. The aspirator shall be a rotary vane air pump allowing for multiple sampling pipe runs up to 91 M per sector, with a response time of 60 seconds.

#### 2.5.3.3 Detector Control Assembly

The detector control assembly shall incorporate the following minimum features:

- a. A programmable intelligent controller capable to setting the level to which the bar graph must rise to initiate scanning.
- b. A 10 pair (20 increment) LED bar graph display.
- c. Two-level security code to access programming feature.
- d. Twelve independent field programmable alarm thresholds.
- e. 0-10 second adjustable time delay setting for the scan level, 0-5 second adjustable time delay setting per sector, and one 0-60 second adjustable time delay setting for a fault condition.
- f. Test, Isolate, Reset and Manual Scan front panel switches.
- g. Thirteen Form C dry contacts, one for each Alert, Action, Fire and one common for Fault conditions.
- h. Detector sensitivity adjustment control of 50 to 200% of full scale sensitivity in 10% increment.
- i. Automatic detector calibration to compensate for detector drift and aging effects.
- j. Programmable latching or non-latching relay operation.
- k. Programmable high and low settings for comprehensive air flow supervision.
- l. Automatic detector supervision, batter status, AC power status.
- m. Comprehensive test function, lamp test, sensitivity test, individual sector alarm threshold levels and air flow levels.
- n. Auxiliary 24 volt 250 mA output.
- o. Remote reset capability.

#### 2.5.3.4 Chart Recorder/Data Log Output

The detector control assembly shall be equipped with an integral cumulative and peak smoke density data logging feature.

#### 2.5.3.5 Digital Communication Port

The digital communication port shall comply with EIA RS485 Protocol.

#### 2.5.3.6 Alarm Settings

Initial settings for each alarm level shall be:

Alarm Level 1 - 40% of bar graph reading (Bar Graph Light 4)  
Alarm Level 2 - 70% of bar graph reading (Bar Graph Light 7)  
Alarm Level 3 - 100% of bar graph reading (Bar Graph Light 10)

Initial time delay setting shall be

Scan Delay: 10 seconds  
Sector Delay: 0 seconds  
Fault: 5 seconds

#### 2.5.3.7 Detector Supervision

The common detector fault relay contacts shall be connected into the appropriate alarm indicating zone on the fire alarm panel in such a way that the detector fault or air flow fault would register a trouble signal on the alarm indicating zone and a common trouble signal on the fire alarm panel.

#### 2.5.3.8 Power Supply and Batteries

Operational system power shall be from fire alarm control panel or dedicated power supplies connected to essential utility power with battery

backup for each detector.

#### 2.5.3.9 Accessories

The sampling pipe network for each sector shall consist of a 20 mm nominal inside diameter copper pipe arranged to provide optimum efficiency in each sector. The air transport time for the least favorable sampling point shall not exceed 60 seconds per sector. Pipe shall comply with Section 15400.

### 2.6 NOTIFICATION APPLIANCES

Audible appliances shall conform to the applicable requirements of UL 464. Devices shall be connected into notification appliance circuits. Devices shall have a separate screw terminal for each conductor. Audible appliances shall generate a unique audible sound from other devices provided in the building and surrounding area. Appliances in rooms without ceiling shall be red (mechanical rooms, electrical rooms, etc.) Appliances in finished rooms (all rooms except mechanical rooms, electrical rooms, electrical closets, and communications closets) and exterior appliances shall be factory finished per section 09915. See attached product cutsheets for submittal.

#### 2.6.1 Visual Notification Appliances

Visual notification appliances shall conform to the applicable requirements of UL 1971 and the contract drawings. Appliances shall have clear high intensity optic lens, xenon flash tubes, and output white light. Strobe flash rate shall be between 1 to 3 flashes per second and a minimum of 75 candela. Strobe shall be surface mounted.

#### 2.6.2 Combination Audible/Visual Notification Appliances

Combination audible/visual notification appliances shall provide the same requirements as individual units except they shall mount as a unit in standard backboxes. Units shall be factory assembled. Any other audible notification appliance employed in the fire alarm systems shall be approved by the Contracting Officer.

#### 2.6.3 Voice Evacuation System

The voice evacuation system shall provide for one-way voice communications, routing and pre-amplification of digital alarm tones and voice (digital and analog) messages. The system shall be zoned for messages (Custom and prerecorded) and tones as indicated on the drawings. The following electronic tones shall be available from the amplifier: Slow Whoop, High/Low, Horn, Chime, Beep, Stutter, Wail and Bell. The system shall have a microphone and allow for general paging within the space. Operation shall be either manually from a control switch or automatically from the fire alarm control panel. Reset shall be accomplished by the fire alarm control panel during panel reset.

### 2.7 FIRE DETECTION AND ALARM SYSTEM PERIPHERAL EQUIPMENT

#### 2.7.1 Electromagnetic Door Hold-Open Devices

Devices shall be attached to the walls unless otherwise indicated. Devices shall comply with the appropriate requirements of UL 228. Devices shall operate on 24 Volt dc power. Compatible magnetic component shall be



attached to the door. Under normal conditions, the magnets shall attract and hold the doors open. When magnets are de-energized, they shall release the doors. Magnets shall have a holding force of 111.2 N (25 pounds). Devices shall be UL or FM approved. Housing for devices shall be brushed aluminum or stainless steel. Operation shall be fail safe with no moving parts. Electromagnetic door hold-open devices shall not be required to be held open during building power failure.

#### 2.7.2 Conduit

Conduit and fittings shall comply with NFPA 70, UL 6, UL 1242, and UL 797.

#### 2.7.3 Wiring

Wiring shall conform to NFPA 70. Wiring for 120 Vac power shall be No. 12 AWG minimum. The SLC wiring shall be copper cable in accordance with the manufacturers requirements. Wiring for fire alarm dc circuits shall be No. 16 AWG minimum. Voltages shall not be mixed in any junction box, housing, or device, except those containing power supplies and control relays. Wiring shall conform to NFPA 70. System field wiring shall be solid copper and installed in metallic conduit or electrical metallic tubing, except that rigid plastic conduit may be used under slab-on-grade. Conductors shall be color coded. Conductors used for the same functions shall be similarly color coded. Wiring code color shall remain uniform throughout the circuit. Pigtail or T-tap connections to initiating device circuits, supervisory alarm circuits, and notification appliance circuits are prohibited. T-tapping using screw terminal blocks is allowed for style 5 addressable systems.

#### 2.7.4 Special Tools and Spare Parts

Software, connecting cables and proprietary equipment, necessary for the maintenance, testing, and reprogramming of the equipment shall be furnished to the Contracting Officer. Two spare fuses of each type and size required shall be furnished. Two percent of the total number of each different type of detector, but no less than two each, shall be furnished. Spare fuses shall be mounted in the fire alarm panel.

### 2.8 TRANSMITTERS

Fiber optics data line interface card, Class A, compatible with the existing base fire alarm system and capable of driving the required distance. See attached product cutsheets for submittal.

### 3.1 INSTALLATION

All work shall be installed as shown, and in accordance with NFPA 70 and NFPA 72, and in accordance with the manufacturer's diagrams and recommendations, unless otherwise specified. Smoke detectors shall not be installed until construction is essentially complete and the building has been thoroughly cleaned.

#### 3.1.1 Power Supply for the System

A single dedicated circuit connection for supplying power from a branch circuit to each building fire alarm system shall be provided. The power shall be supplied as shown on the drawings. The power supply shall be equipped with a locking mechanism and marked in red with the words "FIRE ALARM CIRCUIT CONTROL".

### 3.1.2 Wiring

Conduit size for wiring shall be in accordance with NFPA 70. Wiring for the fire alarm system shall not be installed in conduits, junction boxes, or outlet boxes with conductors of lighting and power systems. Not more than two conductors shall be installed under any device screw terminal. The wires under the screw terminal shall be straight when placed under the terminal then clamped in place under the screw terminal. The wires shall be broken and not twisted around the terminal. Circuit conductors entering or leaving any mounting box, outlet box enclosure, or cabinet shall be connected to screw terminals with each terminal and conductor marked in accordance with the wiring diagram. Connections and splices shall be made using screw terminal blocks. The use of wire nut type connectors in the system is prohibited. Wiring within any control equipment shall be readily accessible without removing any component parts. The fire alarm equipment manufacturer's representative shall be present for the connection of wiring to the control panel.

### 3.1.3 Control Panel

The control panel and its assorted components shall be mounted so that no part of the enclosing cabinet is less than 300 mm nor more than 2000 mm above the finished floor. Manually operable controls shall be between 900 and 1100 mm above the finished floor. Panel shall be installed to comply with the requirements of UL 864. Contractor shall provide a complete control panel and system configuration and programming including device addressing, type of device, WAC zone device, description of physical location system output functions, and annunciator display messages.

### 3.1.4 Detectors

Detectors shall be located and installed in accordance with NFPA 72. Detectors shall be connected into signal line circuits or initiating device circuits as indicated on the drawings. Detectors shall be at least 300 mm from any part of any lighting fixture. Detectors shall be located at least 900 mm from diffusers of air handling systems. Each detector shall be provided with appropriate mounting hardware as required by its mounting location. Detectors which mount in open space shall be mounted directly to the end of the stubbed down rigid conduit drop. Conduit drops shall be firmly secured to minimize detector sway. Where length of conduit drop from ceiling or wall surface exceeds 900 mm, sway bracing shall be provided. Detectors installed in concealed locations (above ceiling, raised floors, etc.) shall have a remote visible indicator LED/LCD in a finished, visible location.

### 3.1.5 Notification Appliances

Notification appliances shall be mounted 2032 mm above the finished floor or 150 mm below the ceiling, whichever is lower. Provide a separate NAC circuit for speakers and a separate NAC circuit for strokes. Do not combine these appliances on the same circuit.

### 3.1.6 Annunciator Equipment

Annunciator equipment shall be mounted where indicated on the drawings.

### 3.1.7 Addressable Initiating Device Circuits Module

The initiating device circuits module shall be used to connect supervised conventional initiating devices (water flow switches, water pressure switches, manual fire alarm stations, high/low air pressure switches, and tamper switches). The module shall mount in an electrical box adjacent to or connected to the device it is monitoring and shall be capable of Style B supervised wiring to the initiating device. In order to maintain proper supervision, there shall be no T-taps allowed on style B lines. Addressable initiating device circuits modules shall monitor only one initiating device each. Contacts in suppression systems and other fire protection subsystems shall be connected to the fire alarm system to perform supervisory and alarm functions as specified in Section 13930 WET PIPE SPRINKLER SYSTEM, FIRE PROTECTION and NFPA 72, as specified herein and as required.

### 3.1.8 Addressable Control Module

Addressable and control modules shall be installed in the outlet box or adjacent to the device they are controlling. If a supplementary suppression releasing panel is provided, then the monitor modules shall be mounted in a common enclosure adjacent to the suppression releasing panel and both this enclosure and the suppression releasing panel shall be in the same room as the releasing devices. All interconnecting wires shall be supervised unless an open circuit or short circuit abnormal condition does not affect the required operation of the fire alarm system. If control modules are used as interfaces to other systems, such as HVAC or elevator control, they shall be within the control panel or immediately adjacent to it. Control modules that control a group of notification appliances shall be adjacent to the first notification appliance in the notification appliance circuits. Control modules that connect to devices shall supervise the notification appliance circuits. Control modules that connect to auxiliary systems or interface with other systems (non-life safety systems) and where not required by NFPA 72, shall not require the secondary circuits to be supervised. Contacts in suppression systems and other fire protection subsystems shall be connected to the fire alarm system to perform required alarm functions as specified in Section 13930A WET PIPE SPRINKLER SYSTEM, FIRE PROTECTION and NFPA 72, as Specified herein and as required.

## 3.2 OVERVOLTAGE AND SURGE PROTECTION

### 3.2.1 Power Line Surge Protection

All equipment connected to alternating current circuits shall be protected from surges per IEEE C62.41 B3 combination waveform and NFPA 70. Fuses shall not be used for surge protection. The surge protector shall be rated for a maximum let thru voltage of 350 Volts ac (line-to-neutral) and 350 Volt ac (neutral-to-ground).

### 3.2.2 Low Voltage DC Circuits Surge Protection

All IDC, NAC, and communication cables/conductors, except fiber optics, shall have surge protection installed at each point where it exits or enters a building. Equipment shall be protected from surges per IEEE C62.41 B3 combination waveform and NFPA 70. The surge protector shall be rated to protect the 24 Volt dc equipment. The maximum dc clamping voltages shall be 36 V (line-to-ground) and 72 Volt dc (line-to-line).

### 3.2.3 Signal Line Circuit Surge Protection

All SLC cables/conductors, except fiber optics, shall have surge protection/isolation circuits installed at each point where it exits or enters a building. The circuit shall be protected from surges per IEEE C62.41 B3 combination waveform and NFPA 70. The surge protector/isolator shall be rated to protect the equipment.

### 3.3 GROUNDING

Grounding shall be provided by connecting to building ground system.

### 3.4 TESTING

The Contractor shall notify the Contracting Officer at least 10 days before the preliminary and acceptance tests are to be conducted. The tests shall be performed in accordance with the approved test procedures in the presence of the Contracting Officer. The control panel manufacturer's representative shall be present to supervise tests. The Contractor shall furnish instruments and personnel required for the tests.

#### 3.4.1 Preliminary Tests

Upon completion of the installation, the system shall be subjected to functional and operational performance tests including tests of each installed initiating and notification appliance, when required. Tests shall include the meggering of system conductors to determine that the system is free from grounded, shorted, or open circuits. The megger test shall be conducted prior to the installation of fire alarm equipment. If deficiencies are found, corrections shall be made and the system shall be retested to assure that it is functional. After completing the preliminary testing the Contractor shall complete and submit the NFPA 72, Certificate of Completion.

#### 3.4.2 Acceptance Test

Acceptance testing shall not be performed until the Contractor has completed and submitted the Certificate of Completion. Testing shall be in accordance with NFPA 72. The recommended tests in NFPA 72 shall be considered mandatory and shall verify that previous deficiencies have been corrected. The Contractor shall complete and submit the NFPA 72, Inspection and Testing Form. The test shall include all requirements of NFPA 72 and the following:

- a. Test of each function of the control panel.
- b. Test of each circuit in both trouble and normal modes.
- c. Tests of each alarm initiating devices in both normal and trouble conditions.
- d. Tests of each control circuit and device.
- e. Tests of each alarm notification appliance.
- f. Tests of the battery charger and batteries.
- g. Complete operational tests under emergency power supply.
- h. Visual inspection of wiring connections.

- i. Opening the circuit at each alarm initiating device and notification appliance to test the wiring supervisory feature.
- j. Ground fault
- k. Short circuit faults
- l. Stray voltage
- m. Loop resistance

### 3.5 TRAINING

Training course shall be provided for the operations and maintenance staff.

The course shall be conducted in the building where the system is installed or as designated by the Contracting Officer. The training period for systems operation shall consist of 2 training days (8 hours per day) and shall start after the system is functionally completed but prior to final acceptance tests. The training period for systems maintenance shall consist of 2 training days (8 hours per day) and shall start after the system is functionally completed but prior to final acceptance tests. The instructions shall cover items contained in the operating and maintenance instructions. In addition, training shall be provided on performance of expansions or modifications to the fire detection and alarm system. The training period for system expansions and modifications shall consist of at least 1 training days (8 hours per day) and shall start after the system is functionally completed but prior to final acceptance tests.

Factory Training: Factory training for 5 persons from the 21 CES personnel. Training shall be scheduled for two groups to occur approximately two months apart. The class title is IRC-3/Signature Installation and Programming and is provided by the EST Institute. This class is ten days long. Information on EST can be obtained on their web site <http://www.est.net>. Lodging, transportation, ground transportation to and from the airport, fees, books, materials, and per diem (at the government rate) shall be provided by the contractor.

-- End of Section --

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## SECTION 13930

WET PIPE SPRINKLER SYSTEM, FIRE PROTECTION  
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## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

## ASTM INTERNATIONAL (ASTM)

ASTM A 135	(2001) Electric-Resistance-Welded Steel Pipe
ASTM A 183	(1998) Carbon Steel Track Bolts and Nuts
ASTM A 193/A 193M	(20001a) Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service
ASTM A 47/A 47M	(1999) Ferritic Malleable Iron Castings
ASTM A 53/A 53M	(2001) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 536	(1984; R 1999e1) Ductile Iron Castings
ASTM A 795	(2000) Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use
ASTM B 62	(1993) Composition Bronze or Ounce Metal Castings
ASTM B 75M	(1999) Seamless Copper Tube (Metric)
ASTM B 88M	(1999) Seamless Copper Water Tube (Metric)
ASTM D 2000	(2001) Rubber Products in Automotive Applications
ASTM F 436M	(1993; R 2000) Hardened Steel Washers (Metric)

## AMERICAN SOCIETY OF SANITARY ENGINEERING (ASSE)

ASSE 1015	(1999) Double Check Backflow Prevention Assemblies and Double Check Fire Protection Backflow Prevention Assemblies
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## AMERICAN WATER WORKS ASSOCIATION(AWWA)

AWWA B300	(1999) Hypochlorites
AWWA B301	(1999) Liquid Chlorine
AWWA C104	(1995) Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
AWWA C110	(1998) Ductile-Iron and Gray-Iron Fittings, 3 In. Through 48 In. (75 mm through 1219 mm), for Water
AWWA C111	(2000) Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA C151	(1996) Ductile-Iron Pipe, Centrifugally Cast, for Water
AWWA C203	(1997; C203a99) Coal-Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot-Applied
AWWA C606	(1997) Grooved and Shouldered Joints
AWWA EWW	(1998) Standard Methods for the Examination of Water and Wastewater
AWWA M20	(1973) Manual: Water Chlorination Principles and Practices

## ASME INTERNATIONAL (ASME)

ASME B16.1	(1998) Cast Iron Pipe Flanges and Flanged Fittings
ASME B16.11	(2001) Forged Fittings, Socket-Welding and Threaded
ASME B16.18	(2001) Cast Copper Alloy Solder Joint Pressure Fittings
ASME B16.21	(1992) Nonmetallic Flat Gaskets for Pipe Flanges
ASME B16.22	(1995) Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
ASME B16.26	(1988) Cast Copper Alloy Fittings for Flared Copper Tubes
ASME B16.3	(1998) Malleable Iron Threaded Fittings
ASME B16.4	(1998) Gray Iron Threaded Fittings
ASME B16.9	(2001) Factory-Made Wrought Steel Buttwelding Fittings
ASME B18.2.1	(1996) Square and Hex Bolts and Screws, Inch Series

## FM GLOBAL (FM)

FM P7825a (2002) Approval Guide Fire Protection  
FM P7825b (2002) Approval Guide Electrical Equipment

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS  
INDUSTRY (MSS)

MSS SP-71 (1997) Gray Iron Swing Check Valves,  
Flanged and Threaded Ends

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 101 (2000) Life Safety Code  
NFPA 13 (1999) Installation of Sprinkler Systems  
NFPA 13D (1999) Installation of Sprinkler Systems  
in One- and Two-Family Dwellings and  
Manufactured Homes Sprinkler Systems  
NFPA 13R (1999) Installation of Sprinkler Systems  
in Residential Occupancies Up to and  
Including Four Stories in Height  
NFPA 1963 (1998) Fire Hose Connections  
NFPA 230 (1999) Fire Protection of Storage  
NFPA 24 (1995) Installation of Private Fire  
Service Mains and Their Appurtenances

NATIONAL INSTITUTE FOR CERTIFICATION IN ENGINEERING TECHNOLOGIES  
(NICET)

NICET 1014-7 (1995) Program Detail Manual for  
Certification in the Field of Fire  
Protection Engineering Technology (Field  
Code 003) Subfield of Automatic Sprinkler  
System Layout

UNDERWRITERS LABORATORIES (UL)

UL 668 (1995; Rev thru Dec 1998) Hose Valves for  
Fire Protection Service  
UL Bld Mat Dir (1999) Building Materials Directory  
UL Fire Prot Dir (2001) Fire Protection Equipment Directory

## 1.2 GENERAL REQUIREMENTS

Wet pipe sprinkler system shall be provided in areas indicated on the drawings. The sprinkler system shall provide fire sprinkler protection for the entire area. Except as modified herein, the system shall be designed and installed in accordance with NFPA 13. Pipe sizes which are not indicated on drawings shall be determined by hydraulic calculation. The Contractor shall design any portions of the sprinkler system that are not indicated on the drawings including locating sprinklers, piping and

equipment, and size piping and equipment when this information is not indicated on the drawings or is not specified herein. The design of the sprinkler system shall be based on hydraulic calculations, and the other provisions specified herein.

#### 1.2.1 Hydraulic Design

The system shall be hydraulically designed to discharge a minimum density of 4.07 L/min per square meter over the hydraulically most demanding 280 square meters of floor area. The minimum pipe size for branch lines in gridded systems shall be 32 mm. Hydraulic calculations shall be in accordance with the Area/Density Method of NFPA 13. Water velocity in the piping shall not exceed 6 m/s.

##### 1.2.1.1 Hose Demand

An allowance for exterior hose streams of 946 L/min shall be added to the sprinkler system demand at the fire hydrant shown on the drawings closest to the point where the water service enters the building.

##### 1.2.1.2 Basis for Calculations

The design of the system shall be based upon a water supply with a static pressure of 586 kPa, and a flow of 4921 L/min at a residual pressure of 483 kPa. Water supply shall be presumed available at the point of connection to existing. Hydraulic calculations shall be based upon the Hazen-Williams formula with a "C" value of 120 for steel piping, 150 for copper tubing, 140 for new cement-lined ductile-iron piping, and 100 for existing underground piping.

#### 1.2.2 Sprinkler Coverage

Sprinklers shall be uniformly spaced on branch lines. In buildings protected by automatic sprinklers, sprinklers shall provide coverage throughout 100 percent of the building. This includes, but is not limited to, telephone rooms, electrical equipment rooms, boiler rooms, switchgear rooms, transformer rooms, and other electrical and mechanical spaces. Coverage per sprinkler shall be in accordance with NFPA 13; as specified in NFPA 13 for extra hazard occupancy but not to exceed 21 square m for light hazard or 12 square m for ordinary hazard occupancies. Exceptions are as follows:

- 1) Facilities that are designed in accordance with NFPA 13R and NFPA 13D.
- 2) Sprinklers may be omitted from small rooms which are exempted for specific occupancies in accordance with NFPA 101.

#### 1.3 COORDINATION OF TRADES

Piping offsets, fittings, and any other accessories required shall be furnished as required to provide a complete installation and to eliminate interference with other construction. Sprinkler shall be installed over and under ducts, piping and platforms when such equipment can negatively effect or disrupt the sprinkler discharge pattern and coverage.

#### 1.4 DELIVERY AND STORAGE

All equipment delivered and placed in storage shall be housed in a manner to preclude any damage from the weather, humidity and temperature

variations, dirt and dust, or other contaminants. Additionally, all pipes shall either be capped or plugged until installed.

#### 1.5 FIELD MEASUREMENTS

The Contractor shall become familiar with all details of the work, verify all dimensions in the field, and shall advise the Contracting Officer of any discrepancy before performing the work.

#### 1.6 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

##### SD-02 Shop Drawings

Shop Drawings; G, AE.

Three copies of the Sprinkler System Shop Drawings, no later than 21 days prior to the start of sprinkler system installation.

As-Built Drawings.

As-built shop drawings, at least 14 days after completion of the Final Tests. The Sprinkler System Drawings shall be updated to reflect as-built conditions after all related work is completed and shall be on reproducible full-size mylar film.

##### SD-03 Product Data

Fire Protection Related Submittals.

A list of the Fire Protection Related Submittals, no later than 7 days after the approval of the Fire Protection Specialist.

Sway Bracing; G, AE.

For systems that are required to be protected against damage from earthquakes, load calculations shall be provided for sizing of sway bracing.

Materials and Equipment; G, AE.

Manufacturer's catalog data included with the Sprinkler System Drawings for all items specified herein. The data shall be highlighted to show model, size, options, etc., that are intended for consideration. Data shall be adequate to demonstrate compliance with all contract requirements. In addition, a complete equipment list that includes equipment description, model number and quantity shall be provided.

Hydraulic Calculations; G, AE.

Hydraulic calculations, including a drawing showing hydraulic reference points and pipe segments.

#### Spare Parts.

Spare parts data shall be included for each different item of material and equipment specified.

#### Preliminary Tests; G, AE.

Proposed procedures for Preliminary Tests, no later than 14 days prior to the proposed start of the tests. Proposed date and time to begin the preliminary tests.

#### Final Acceptance Test; G, AE.

Proposed procedures for Final Acceptance Test, no later than 14 days prior to the proposed start of the tests. Proposed date and time to begin Final Acceptance Test, submitted with the Final Acceptance Test Procedures. Notification shall be provided at least 14 days prior to the proposed start of the test. Notification shall include a copy of the Contractor's Material & Test Certificates.

#### On-site Training; G, AE.

Proposed On-site Training schedule, at least 14 days prior to the start of related training.

#### Fire Protection Specialist; G; AE.

The name and documentation of certification of the proposed Fire Protection Specialists, no later than 14 days after the Notice to Proceed and prior to the submittal of the sprinkler system drawings and hydraulic calculations.

#### Sprinkler System Installer; G, AE.

The name and documentation of certification of the proposed Sprinkler System Installer, concurrent with submittal of the Fire Protection Specialist Qualifications.

### SD-06 Test Reports

#### Preliminary Test Report; G; AE.

Three copies of the completed Preliminary Test Report, no later than 7 days after the completion of the Preliminary Tests. The Preliminary Tests Report shall include both the Contractor's Material and Test Certificate for Underground Piping and the Contractor's Material and Test Certificate for Aboveground Piping.

All items in the Preliminary Tests Report shall be signed by the Fire Protection Specialist.

#### Final Acceptance Test Report; G, AE.

Three copies of the completed Final Acceptance Tests Reports, no later than 7 days after the completion of the Final Acceptance Tests. All items in the Final Acceptance Report shall be signed by the Fire Protection Specialist.

### SD-07 Certificates

Inspection by Fire Protection Specialist; G, AE.

Concurrent with the Final Acceptance Test Report, certification by the Fire Protection Specialist that the sprinkler system is installed in accordance with the contract requirements, including signed approval of the Preliminary and Final Acceptance Test Reports.

#### SD-10 Operation and Maintenance Data

Operation and Maintenance Instructions.

Six manuals listing step-by-step procedures required for system startup, operation, shutdown, and routine maintenance, at least 14 days prior to field training. The manuals shall include the manufacturer's name, model number, parts list, list of parts and tools that should be kept in stock by the owner for routine maintenance including the name of a local supplier, simplified wiring and controls diagrams, troubleshooting guide, and recommended service organization (including address and telephone number) for each item of equipment.

### 1.7 HYDRAULIC CALCULATIONS

Hydraulic calculations shall be as outlined in NFPA 13 except that calculations shall be performed by computer using software intended specifically for fire protection system design using the design data shown on the drawings. Software that uses k-factors for typical branch lines is not acceptable. Calculations shall be based on the water supply data shown on the drawings. Calculations shall substantiate that the design area used in the calculations is the most demanding hydraulically. Water supply curves and system requirements shall be plotted on semi-logarithmic graph paper so as to present a summary of the complete hydraulic calculation. A summary sheet listing sprinklers in the design area and their respective hydraulic reference points, elevations, actual discharge pressures and actual flows shall be provided. Elevations of hydraulic reference points (nodes) shall be indicated. Documentation shall identify each pipe individually and the nodes connected thereto. The diameter, length, flow, velocity, friction loss, number and type fittings, total friction loss in the pipe, equivalent pipe length and Hazen-Williams coefficient shall be indicated for each pipe. For gridded systems, calculations shall show peaking of demand area friction loss to verify that the hydraulically most demanding area is being used. Also for gridded systems, a flow diagram indicating the quantity and direction of flows shall be included. A drawing showing hydraulic reference points (nodes) and pipe designations used in the calculations shall be included and shall be independent of shop drawings.

### 1.8 FIRE PROTECTION SPECIALIST

Work specified in this section shall be performed under the supervision of and certified by the Fire Protection Specialist. The Fire Protection Specialist shall be an individual who is a registered professional engineer and a Full Member of the Society of Fire Protection Engineers or who is certified as a Level III Technician by National Institute for Certification in Engineering Technologies (NICET) in the Automatic Sprinkler System Layout subfield of Fire Protection Engineering Technology in accordance with NICET 1014-7. The Fire Protection Specialist shall be regularly



engaged in the design and installation of the type and complexity of system specified in the Contract documents, and shall have served in a similar capacity for at least three systems that have performed in the manner intended for a period of not less than 6 months.

#### 1.9 SPRINKLER SYSTEM INSTALLER

Work specified in this section shall be performed by the Sprinkler System Installer. The Sprinkler System Installer shall be regularly engaged in the installation of the type and complexity of system specified in the Contract documents, and shall have served in a similar capacity for at least three systems that have performed in the manner intended for a period of not less than 6 months.

#### 1.10 REGULATORY REQUIREMENTS

Compliance with referenced NFPA standards is mandatory. This includes advisory provisions listed in the appendices of such standards, as though the word "shall" had been substituted for the word "should" wherever it appears. In the event of a conflict between specific provisions of this specification and applicable NFPA standards, this specification shall govern. Reference to "authority having jurisdiction" shall be interpreted to mean the Contracting Officer.

#### 1.11 SPARE PARTS

The Contractor shall submit spare parts data for each different item of material and equipment specified. The data shall include a complete list of parts and supplies, with current unit prices and source of supply, and a list of parts recommended by the manufacturer to be replaced after 1 year and 3 years of service. A list of special tools and test equipment required for maintenance and testing of the products supplied by the Contractor shall be included.

#### 1.12 SHOP DRAWINGS

The Sprinkler System Shop Drawings shall conform to the requirements established for working plans as prescribed in NFPA 13. Drawings shall include plan and elevation views demonstrating that the equipment will fit the allotted spaces with clearance for installation and maintenance. Each set of drawings shall include the following:

- a. Descriptive index of drawings in the submittal with drawings listed in sequence by drawing number. A legend identifying device symbols, nomenclature, and conventions used.

- b. Floor plans drawn to a scale not less than 1:100 which clearly show locations of sprinklers, risers, pipe hangers, seismic separation assemblies, sway bracing, inspector's test connections, drains, and other applicable details necessary to clearly describe the proposed arrangement. Each type of fitting used and the locations of bushings, reducing couplings, and welded joints shall be indicated.

- c. Actual center-to-center dimensions between sprinklers on branch lines and between branch lines; from end sprinklers to adjacent walls; from walls to branch lines; from sprinkler feed mains, cross-mains and branch lines to finished floor and roof or ceiling. A detail shall show the dimension from the sprinkler and

sprinkler deflector to the ceiling in finished areas.

d. Longitudinal and transverse building sections showing typical branch line and cross-main pipe routing as well as elevation of each typical sprinkler above finished floor.

e. Details of each type of riser assembly; pipe hanger; sway bracing for earthquake protection, and restraint of underground water main at point-of-entry into the building, and electrical devices and interconnecting wiring.

## PART 2 PRODUCTS

### 2.1 STANDARD PRODUCTS

Materials and equipment shall be standard products of a manufacturer regularly engaged in the manufacture of such products and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening.

### 2.2 NAMEPLATES

All equipment shall have a nameplate that identifies the manufacturer's name, address, type or style, model or serial number, and catalog number.

### 2.3 REQUIREMENTS FOR FIRE PROTECTION SERVICE

Materials and Equipment shall have been tested by Underwriters Laboratories, Inc. and listed in UL Fire Prot Dir or approved by Factory Mutual and listed in FM P7825a and FM P7825b. Where the terms "listed" or "approved" appear in this specification, such shall mean listed in UL Fire Prot Dir or FM P7825a and FM P7825b

### 2.4 UNDERGROUND PIPING COMPONENTS

#### 2.4.1 Pipe

Piping from a point 150 mm above the floor to a point 1500 mm outside the building wall shall be ductile iron with a rated working pressure of 1034 kPa conforming to AWWA C151, with cement mortar lining conforming to AWWA C104. Piping more than 1500 mm outside the building walls shall comply with Section 02510A WATER DISTRIBUTION SYSTEM.

#### 2.4.2 Fittings and Gaskets

Fittings shall be ductile iron conforming to AWWA C110. Gaskets shall be suitable in design and size for the pipe with which such gaskets are to be used. Gaskets for ductile iron pipe joints shall conform to AWWA C111.

#### 2.4.3 Gate Valve and Indicator Posts

Gate valves for underground installation shall be of the inside screw type with counter-clockwise rotation to open. Where indicating type valves are shown or required, indicating valves shall be gate valves with an approved indicator post of a length to permit the top of the post to be located 900 mm above finished grade. Gate valves and indicator posts shall be listed in UL Fire Prot Dir or FM P7825a and FM P7825b.

### 2.5 ABOVEGROUND PIPING COMPONENTS

Aboveground piping shall be steel or copper.

## 2.5.1 Steel Piping Components

### 2.5.1.1 Steel Pipe

Except as modified herein, steel pipe shall be black as permitted by NFPA 13 and shall conform to applicable provisions of ASTM A 795, ASTM A 53/A 53M, or ASTM A 135. Pipe in which threads or grooves are cut shall be Schedule 40 or shall be listed by Underwriters' Laboratories to have a corrosion resistance ratio (CRR) of 1.0 or greater after threads or grooves are cut. Pipe shall be marked with the name of the manufacturer, kind of pipe, and ASTM designation.

### 2.5.1.2 Fittings for Non-Grooved Steel Pipe

Fittings shall be cast iron conforming to ASME B16.4, steel conforming to ASME B16.9 or ASME B16.11, or malleable iron conforming to ASME B16.3. Steel press fittings shall be approved for fire protection systems. Galvanized fittings shall be used for piping systems or portions of piping systems utilizing galvanized piping. Fittings into which sprinklers, drop nipples or riser nipples (sprigs) are screwed shall be threaded type. Plain-end fittings with mechanical couplings, fittings that use steel gripping devices to bite into the pipe and segmented welded fittings shall not be used.

### 2.5.1.3 Grooved Mechanical Joints and Fittings

Joints and fittings shall be designed for not less than 1200 kPa service and shall be the product of the same manufacturer; segmented welded fittings shall not be used. Fitting and coupling houses shall be malleable iron conforming to ASTM A 47/A 47M, Grade 32510; ductile iron conforming to ASTM A 536, Grade 65-45-12. Gasket shall be the flush type that fills the entire cavity between the fitting and the pipe. Nuts and bolts shall be heat-treated steel conforming to ASTM A 183 and shall be cadmium plated or zinc electroplated.

### 2.5.1.4 Flanges

Flanges shall conform to NFPA 13 and ASME B16.1. Gaskets shall be non-asbestos compressed material in accordance with ASME B16.21, 1.6 mm thick, and full face or self-centering flat ring type.

### 2.5.1.5 Bolts, Nut, and Washers

Bolts shall be squarehead conforming to ASME B18.2.1 and shall extend no less than three full threads beyond the nut with bolts tightened to the required torque. Nuts shall be ASTM A 193/A 193M, Grade 5. Washers shall meet the requirements of ASTM F 436M. Flat circular washers shall be provided under all bolt heads and nuts.

## 2.5.2 Copper Tube Components

### 2.5.2.1 Copper Tube

Copper tube shall conform to ASTM B 88M, Types L and M.

### 2.5.2.2 Copper Fittings and Joints

Cast copper alloy solder-joint pressure fittings shall conform to ASME B16.18 and wrought copper and bronze solder-joint pressure fittings shall conform to ASME B16.22 and ASTM B 75M. Cast copper alloy fittings for flared copper tube shall conform to ASME B16.26 and ASTM B 62. Brass or bronze adapters for brazed tubing may be used for connecting tubing to flanges and to threaded ends of valves and equipment. Extracted brazed tee joints produced with an acceptable tool and installed as recommended by the manufacturer may be used. Grooved mechanical joints and fittings shall be designed for not less than 862 kPa service and shall be the product of the same manufacturer. Grooved fitting and mechanical coupling housing shall be ductile iron conforming to ASTM A 536. Gaskets for use in grooved joints shall be molded synthetic polymer of pressure responsive design and shall conform to ASTM D 2000 for circulating medium up to 110 degrees C. Grooved joints shall conform to AWWA C606. Coupling nuts and bolts for use in grooved joints shall be steel and shall conform to ASTM A 183.

### 2.5.3 Pipe Hangers

Hangers shall be listed in UL Fire Prot Dir or FM P7825a and FM P7825b and of the type suitable for the application, construction, and pipe type and sized to be supported.

### 2.5.4 Valves

#### 2.5.4.1 Control Valve and Gate Valve

Manually operated sprinkler control valve and gate valve shall be outside stem and yoke (OS&Y) type and shall be listed in UL Bld Mat Dir or FM P7825a and FM P7825b.

#### 2.5.4.2 Check Valve

Check valve 50 mm and larger shall be listed in UL Bld Mat Dir or FM P7825a and FM P7825b. Check valves 100 mm and larger shall be of the swing type with flanged cast iron body and flanged inspection plate, shall have a clear waterway and shall meet the requirements of MSS SP-71, for Type 3 or 4.

#### 2.5.4.3 Hose Valve

Valve shall comply with UL 668 and shall have a minimum rating of 2070 kPa. Valve shall be non-rising stem, all bronze, 90 degree angle type, with 65 mm American National Standard Fire Hose Screw Thread (NH) male outlet in accordance with NFPA 1963. Hose valve shall be provided with 65 to 40 mm reducer. Hose valves shall be equipped with lugged cap with drip drain, cap gasket and chain. Valve finish shall match existing.

### 2.6 ALARM CHECK VALVE ASSEMBLY

Assembly shall include an alarm check valve, standard trim piping, pressure gauges, bypass, retarding chamber, testing valves, main drain, and other components as required for a fully operational system.

### 2.7 WATERFLOW ALARM

Electrically operated, exterior-mounted, waterflow alarm bell shall be provided and installed in accordance with NFPA 13. Waterflow alarm bell shall be rated 24 VDC and shall be connected to the Fire Alarm Control

Panel(FACP) in accordance with Section 13851A FIRE DETECTION AND ALARM SYSTEM, ADDRESSABLE.

## 2.8 ALARM INITIATING AND SUPERVISORY DEVICES

### 2.8.1 Sprinkler Waterflow Indicator Switch, Vane Type

Switch shall be vane type with a pipe saddle and cast aluminum housing. The electro-mechanical device shall include a flexible, low-density polyethylene paddle conforming to the inside diameter of the fire protection pipe. The device shall sense water movements and be capable of detecting a sustained flow of 38 L/min or greater. The device shall contain a retard device adjustable from 0 to 90 seconds to reduce the possibility of false alarms caused by transient flow surges. The switch shall be tamper resistant and contain two SPDT (Form C) contacts arranged to transfer upon removal of the housing cover, and shall be equipped with a silicone rubber gasket to assure positive water seal and a dustproof cover and gasket to seal the mechanism from dirt and moisture.

### 2.8.2 Sprinkler Pressure (Waterflow) Alarm Switch

Pressure switch shall include a metal housing with a neoprene diaphragm, SPDT snap action switches and a 15 mm NPT male pipe thread. The switch shall have a maximum service pressure rating of 1207 kPa. There shall be two SPDT (Form C) contacts factory adjusted to operate at 28 to 55 kPa. The switch shall be capable of being mounted in any position in the alarm line trim piping of the alarm check valve.

### 2.8.3 Valve Supervisory (Tamper) Switch

Switch shall be suitable for mounting to the type of control valve to be supervised open. The switch shall be tamper resistant and contain one set of SPDT (Form C) contacts arranged to transfer upon removal of the housing cover or closure of the valve of more than two rotations of the valve stem.

## 2.9 FIRE DEPARTMENT CONNECTION

Fire department connection shall be flush type with cast brass body, matching wall escutcheon lettered "Auto Spkr" with a polished brass finish. The connection shall have two inlets with individual self-closing clappers, caps with drip drains and chains. Female inlets shall have 65 mm diameter American National Fire Hose Connection Screw Threads (NH) per NFPA 1963.

## 2.10 SPRINKLERS

Sprinklers with internal O-rings shall not be used. Sprinklers shall be used in accordance with their listed coverage limitations. Temperature classification shall be ordinary. Sprinklers in high heat areas including attic spaces or in close proximity to unit heaters shall have temperature classification in accordance with NFPA 13. Extended coverage sprinklers shall not be used.

### 2.10.1 Concealed Sprinkler

Concealed sprinkler shall be white polyester and shall have a nominal 12.7 mm or 13.5 mm orifice.

### 2.10.2 Pendent Sprinkler

Pendent sprinkler shall be of the fusible strut or glass bulb type, type with nominal 12.7 mm orifice. Pendent sprinklers shall have a white polyester finish.

#### 2.10.3 Upright Sprinkler

Upright sprinkler shall be brass and shall have a nominal 12.7 mm or 13.5 mm orifice.

#### 2.10.4 Sidewall Sprinkler

Sidewall sprinkler shall have a nominal 12.7 mm orifice. Sidewall sprinkler shall have a brass finish. Sidewall sprinkler shall be the quick-response type.

### 2.11 DISINFECTING MATERIALS

#### 2.11.1 Liquid Chlorine

Liquid chlorine shall conform to AWWA B301.

#### 2.11.2 Hypochlorites

Calcium hypochlorite and sodium hypochlorite shall conform to AWWA B300.

### 2.12 ACCESSORIES

#### 2.12.1 Sprinkler Cabinet

Spare sprinklers shall be provided in accordance with NFPA 13 and shall be packed in a suitable metal or plastic cabinet. Spare sprinklers shall be representative of, and in proportion to, the number of each type and temperature rating of the sprinklers installed. At least one wrench of each type required shall be provided.

#### 2.12.2 Pendent Sprinkler Escutcheon

Escutcheon shall be one-piece metallic type with a depth of less than 20 mm and suitable for installation on pendent sprinklers. The escutcheon shall have a factory finish that matches the pendent sprinkler heads.

#### 2.12.3 Pipe Escutcheon

Escutcheon shall be polished chromium-plated zinc alloy, or polished chromium-plated copper alloy. Escutcheons shall be either one-piece or split-pattern, held in place by internal spring tension or set screw.

#### 2.12.4 Sprinkler Guard

Guard shall be a steel wire cage designed to encase the sprinkler and protect it from mechanical damage. Guards shall be provided on sprinklers located as indicated.

#### 2.12.5 Identification Sign

Valve identification sign shall be minimum 150 mm wide x 50 mm high with enamel baked finish on minimum 1.214 mm steel or 0.6 mm aluminum with red letters on a white background or white letters on red background. Wording

of sign shall include, but not be limited to "main drain," "auxiliary drain," "inspector's test," "alarm test," "alarm line," and similar wording as required to identify operational components.

### 2.13 FIRE HOSE REEL ASSEMBLY

Assembly shall include nozzle, fire hose, reel, 40 mm valve, and bracket suitable for wall mounting. The assembly shall be semi-automatic type complete with Underwriters clip which permits controlled one-man operation whereby control valve can be opened, hose unreeled and clip released by pulling on hose. Valve shall be non-rising stem, all bronze, angle type with 40 mm American National Standard Fire Hose Screw Thread (NH) male outlet in accordance with NFPA 1963. Reel shall be of steel construction with red enamel finish and shall be equipped with 30 meters of 40 mm rubber lined fire hose. Nozzle shall be of the industrial combination fog-straight stream type with shutoff. Components of the assembly shall be listed in UL Fire Prot Dir.

### 2.14 DOUBLE-CHECK VALVE BACKFLOW PREVENTION ASSEMBLY

Double-check backflow prevention assembly shall comply with ASSE 1015. The assembly shall have a bronze, cast-iron or stainless steel body with flanged ends. The assembly shall include pressure gauge test ports and OS&Y shutoff valves on the inlet and outlet, 2-positive-seating check valve for continuous pressure application, and four test cocks. Assemblies shall be rated for working pressure of 1034 kPa. The maximum pressure loss shall be 40 kPa at a flow rate equal to the sprinkler water demand, at the location of the assembly. A test port for a pressure gauge shall be provided both upstream and downstream of the double check backflow prevention assembly valves.

## PART 3 EXECUTION

### 3.1 FIRE PROTECTION RELATED SUBMITTALS

The Fire Protection Specialist shall prepare a list of the submittals from the Contract Submittal Register that relate to the successful installation of the sprinkler systems(s). The submittals identified on this list shall be accompanied by a letter of approval signed and dated by the Fire Protection Specialist when submitted to the Government.

### 3.2 INSTALLATION REQUIREMENTS

The installation shall be in accordance with the applicable provisions of NFPA 13, NFPA 24 and publications referenced therein. Installation of in-rack sprinklers shall comply with applicable provisions of NFPA 230.

### 3.3 INSPECTION BY FIRE PROTECTION SPECIALIST

The Fire Protection Specialist shall inspect the sprinkler system periodically during the installation to assure that the sprinkler system is being provided and installed in accordance with the contract requirements. The Fire Protection Specialist shall witness the preliminary and final tests, and shall sign the test results. The Fire Protection Specialist, after completion of the system inspections and a successful final test, shall certify in writing that the system has been installed in accordance with the contract requirements. Any discrepancy shall be brought to the attention of the Contracting Officer in writing, no later than three working days after the discrepancy is discovered.

### 3.4 ABOVEGROUND PIPING INSTALLATION

#### 3.4.1 Protection of Piping Against Earthquake Damage

The system piping shall be protected against damage from earthquakes. Seismic protection shall include flexible and rigid couplings, sway bracing, seismic separation assemblies where piping crosses building seismic separation joints, and other features as required by NFPA 13 for protection of piping against damage from earthquakes.

#### 3.4.2 Piping in Exposed Areas

Exposed piping shall be installed so as not to diminish exit access widths, corridors or equipment access. Exposed horizontal piping, including drain piping, shall be installed to provide maximum headroom.

#### 3.4.3 Piping in Finished Areas

In areas with suspended or dropped ceilings and in areas with concealed spaces above the ceiling, piping shall be concealed above ceilings. Piping shall be inspected, tested and approved before being concealed. Risers and similar vertical runs of piping in finished areas shall be concealed.

#### 3.4.4 Pendent Sprinklers

Drop nipples to pendent sprinklers shall consist of minimum 25 mm pipe with a reducing coupling into which the sprinkler shall be threaded. Hangers shall be provided on arm-overs to drop nipples supplying pendent sprinklers when the arm-over exceeds 300 mm. Where sprinklers are installed below suspended or dropped ceilings, drop nipples shall be cut such that sprinkler ceiling plates or escutcheons are of a uniform depth throughout the finished space. The outlet of the reducing coupling shall not extend more than 25 mm below the underside of the ceiling. On pendent sprinklers installed below suspended or dropped ceilings, the distance from the sprinkler deflector to the underside of the ceiling shall not exceed 100 mm. Recessed pendent sprinklers shall be installed such that the distance from the sprinkler deflector to the underside of the ceiling shall not exceed the manufacturer's listed range and shall be of uniform depth throughout the finished area.

##### 3.4.4.1 Pendent Sprinkler Locations

Pendent sprinklers in suspended ceilings shall be a minimum of 150 mm from ceiling grid.

#### 3.4.5 Upright Sprinklers

Riser nipples or "sprigs" to upright sprinklers shall contain no fittings between the branch line tee and the reducing coupling at the sprinkler. Riser nipples exceeding 750 mm in length shall be individually supported.

#### 3.4.6 Pipe Joints

Pipe joints shall conform to NFPA 13, except as modified herein. Not more than four threads shall show after joint is made up. Welded joints will be permitted, only if welding operations are performed as required by NFPA 13 at the Contractor's fabrication shop, not at the project construction site. Flanged joints shall be provided where indicated or required by NFPA 13.



Grooved pipe and fittings shall be prepared in accordance with the manufacturer's latest published specification according to pipe material, wall thickness and size. Grooved couplings, fittings and grooving tools shall be products of the same manufacturer. For copper tubing, pipe and groove dimensions shall comply with the tolerances specified by the coupling manufacturer. The diameter of grooves made in the field shall be measured using a "go/no-go" gauge, vernier or dial caliper, narrow-land micrometer, or other method specifically approved by the coupling manufacturer for the intended application. Groove width and dimension of groove from end of pipe shall be measured and recorded for each change in grooving tool setup to verify compliance with coupling manufacturer's tolerances. Grooved joints shall not be used in concealed locations, such as behind solid walls or ceilings, unless an access panel is shown on the drawings for servicing or adjusting the joint.

#### 3.4.7 Reducers

Reductions in pipe sizes shall be made with one-piece tapered reducing fittings. The use of grooved-end or rubber-gasketed reducing couplings will not be permitted. When standard fittings of the required size are not manufactured, single bushings of the face type will be permitted. Where used, face bushings shall be installed with the outer face flush with the face of the fitting opening being reduced. Bushings shall not be used in elbow fittings, in more than one outlet of a tee, in more than two outlets of a cross, or where the reduction in size is less than 15 mm.

#### 3.4.8 Pipe Penetrations

Cutting structural members for passage of pipes or for pipe-hanger fastenings will not be permitted. Pipes that must penetrate concrete or masonry walls or concrete floors shall be core-drilled and provided with pipe sleeves. Each sleeve shall be Schedule 40 galvanized steel, ductile iron or cast iron pipe and shall extend through its respective wall or floor and be cut flush with each wall surface. Sleeves shall provide required clearance between the pipe and the sleeve per NFPA 13. The space between the sleeve and the pipe shall be firmly packed with mineral wool insulation. Where pipes penetrate fire walls, fire partitions, or floors, pipes shall be fire stopped in accordance with Section 07840 FIRESTOPPING. In penetrations that are not fire-rated or not a floor penetration, the space between the sleeve and the pipe shall be sealed at both ends with plastic waterproof cement that will dry to a firm but pliable mass or with a mechanically adjustable segmented elastomer seal.

#### 3.4.9 Escutcheons

Escutcheons shall be provided for pipe penetration of ceilings and walls. Escutcheons shall be securely fastened to the pipe at surfaces through which piping passes.

#### 3.4.10 Inspector's Test Connection

Unless otherwise indicated, test connection shall consist of 25 mm pipe connected to the remote branch line or at the riser as a combination test and drain valve; a test valve located approximately 2 meters above the floor; a smooth bore brass outlet equivalent to the smallest orifice sprinkler used in the system; and a painted metal identification sign affixed to the valve with the words "Inspector's Test." The discharge orifice shall be located outside the building wall directed so as not to cause damage to adjacent construction or landscaping during full flow

discharge.

#### 3.4.11 Drains

Main drain piping shall be provided to discharge at the location indicated. Auxiliary drains shall be provided as required by NFPA 13.

#### 3.4.12 Installation of Fire Department Connection

Connection shall be mounted on the exterior wall approximately 900 mm above finished grade. The piping between the connection and the check valve shall be provided with an automatic drip in accordance with NFPA 13 and arranged to drain to the outside.

#### 3.4.13 Identification Signs

Signs shall be affixed to each control valve, inspector test valve, main drain, auxiliary drain, test valve, and similar valves as appropriate or as required by NFPA 13. Hydraulic design data nameplates shall be permanently affixed to each sprinkler riser as specified in NFPA 13.

### 3.5 UNDERGROUND PIPING INSTALLATION

The fire protection water main shall be laid, and joints anchored, in accordance with NFPA 24. Minimum depth of cover shall be 1500 mm. The supply line shall terminate inside the building with a flanged piece, the bottom of which shall be set not less than 150 mm above the finished floor.

A blind flange shall be installed temporarily on top of the flanged piece to prevent the entrance of foreign matter into the supply line. A concrete thrust block shall be provided at the elbow where the pipe turns up toward the floor. In addition, joints shall be anchored in accordance with NFPA 24 using pipe clamps and steel rods from the elbow to the flange above the floor and from the elbow to a pipe clamp in the horizontal run of pipe. Buried steel components shall be provided with a corrosion protective coating in accordance with AWWA C203. Piping more than 1500 mm outside the building walls shall meet the requirements of Section 02510 WATER DISTRIBUTION SYSTEM.

### 3.6 EARTHWORK

Earthwork shall be performed in accordance with applicable provisions of Section 02315 EXCAVATION, FILLING AND BACKFILLING FOR BUILDINGS.

### 3.7 ELECTRICAL WORK

Except as modified herein, electric equipment and wiring shall be in accordance with Section 16415 ELECTRICAL WORK, INTERIOR. Alarm signal wiring connected to the building fire alarm control system shall be in accordance with Section 13851 FIRE DETECTION AND ALARM SYSTEM, ADDRESSABLE.

Wiring color code shall remain uniform throughout the system.

### 3.8 DISINFECTION

After all system components are installed and hydrostatic test(s) are successfully completed, each portion of the sprinkler system to be disinfected shall be thoroughly flushed with potable water until all entrained dirt and other foreign materials have been removed before introducing chlorinating material. Flushing shall be conducted by removing the flushing fitting of the cross mains and of the grid branch lines, and

then back-flushing through the sprinkler main drains. The chlorinating material shall be hypochlorites or liquid chlorine. Water chlorination procedure shall be in accordance with AWWA M20. The chlorinating material shall be fed into the sprinkler piping at a constant rate of 50 parts per million (ppm). A properly adjusted hypochlorite solution injected into the system with a hypochlorinator, or liquid chlorine injected into the system through a solution-fed chlorinator and booster pump shall be used. Chlorination application shall continue until the entire system is filled. The water shall remain in the system for a minimum of 24 hours. Each valve in the system shall be opened and closed several times to ensure its proper disinfection. Following the 24-hour period, no less than 25 ppm chlorine residual shall remain in the system. The system shall then be flushed with clean water until the residual chlorine is reduced to less than one part per million. Samples of water in disinfected containers for bacterial examination will be taken from several system locations which are approved by the Contracting Officer. Samples shall be tested for total coliform organisms (coliform bacteria, fecal coliform, streptococcal, and other bacteria) in accordance with AWWA EWW. The testing method shall be either the multiple-tube fermentation technique or the membrane-filter technique. The disinfection shall be repeated until tests indicate the absence of coliform organisms (zero mean coliform density per 100 milliliters) in the samples for at least 2 full days. The system will not be accepted until satisfactory bacteriological results have been obtained. After successful completion, verify installation of all sprinklers and plugs and pressure test the system.

### 3.9 PIPE COLOR CODE MARKING

Color code marking of piping shall be as specified in Section 09900 PAINTS AND COATINGS.

### 3.10 PRELIMINARY TESTS

The system, including the underground water mains, and the aboveground piping and system components, shall be tested to assure that equipment and components function as intended. The underground and aboveground interior piping systems and attached appurtenances subjected to system working pressure shall be tested in accordance with NFPA 13 and NFPA 24. Upon completion of specified tests, the Contractor shall complete certificates as specified in paragraph SUBMITTALS.

#### 3.10.1 Underground Piping

##### 3.10.1.1 Flushing

Underground piping shall be flushed in accordance with NFPA 24. This includes the requirement to flush the lead-in connection to the fire protection system at a flow rate not less than the calculated maximum water demand rate of the system.

##### 3.10.1.2 Hydrostatic Testing

New underground piping shall be hydrostatically tested in accordance with NFPA 24. The allowable leakage shall be measured at the specified test pressure by pumping from a calibrated container. The amount of leakage at the joints shall not exceed 1.89 liters per hour per 100 gaskets or joints, regardless of pipe diameter.

#### 3.10.2 Aboveground Piping

### 3.10.2.1 Hydrostatic Testing

Aboveground piping shall be hydrostatically tested in accordance with NFPA 13 at not less than 1400 kPa or 350 kPa in excess of maximum system operating pressure and shall maintain that pressure without loss for 2 hours. There shall be no drop in gauge pressure or visible leakage when the system is subjected to the hydrostatic test. The test pressure shall be read from a gauge located at the low elevation point of the system or portion being tested.

### 3.10.2.2 Backflow Prevention Assembly Forward Flow Test

Each backflow prevention assembly shall be tested at system flow demand, including all applicable hose streams, as specified in NFPA 13. The Contractor shall provide all equipment and instruments necessary to conduct a complete forward flow test, including 65 mm diameter hoses, playpipe nozzles, calibrated pressure gauges, and pitot tube gauge. The Contractor shall provide all necessary supports to safely secure hoses and nozzles during the test. At the system demand flow, the pressure readings and pressure drop (friction) across the assembly shall be recorded. A metal placard shall be provided on the backflow prevention assembly that lists the pressure readings both upstream and downstream of the assembly, total pressure drop, and the system test flow rate. The pressure drop shall be compared to the manufacturer's data.

### 3.10.3 Testing of Alarm Devices

Each alarm switch shall be tested by flowing water through the inspector's test connection. Each water-operated alarm devices shall be tested to verify proper operation.

### 3.10.4 Main Drain Flow Test

Following flushing of the underground piping, a main drain test shall be made to verify the adequacy of the water supply. Static and residual pressures shall be recorded on the certificate specified in paragraph SUBMITTALS. In addition, a main drain test shall be conducted each time after a main control valve is shut and opened.

## 3.11 FINAL ACCEPTANCE TEST

Final Acceptance Test shall begin only when the Preliminary Test Report has been approved. The Fire Protection Specialist shall conduct the Final Acceptance Test and shall provide a complete demonstration of the operation of the system. This shall include operation of control valves and flowing of inspector's test connections to verify operation of associated waterflow alarm switches. After operation of control valves has been completed, the main drain test shall be repeated to assure that control valves are in the open position. In addition, the representative shall have available copies of as-built drawings and certificates of tests previously conducted. The installation shall not be considered accepted until identified discrepancies have been corrected and test documentation is properly completed and received. The Contractor shall submit the Final Acceptance Test Report as specified in the Submittals paragraph.

## 3.12 ON-SITE TRAINING

The Fire Protection Specialist shall conduct a training course for

operating and maintenance personnel as designated by the Contracting Officer. Training shall be provided for a period of 4 hours of normal working time and shall start after the system is functionally complete but prior to the Preliminary Tests and Final Acceptance Test. The On-Site Training shall cover all of the items contained in the approved Operating and Maintenance Instructions.

-- End of Section --

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## SECTION 13935

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03/03

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## SECTION 13935

DRY PIPE SPRINKLER SYSTEM, FIRE PROTECTION  
**03/03**

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 135	(2001) Electric-Resistance-Welded Steel Pipe
ASTM A 183	(1998) Carbon Steel Track Bolts and Nuts
ASTM A 193/A 193M	(2001b) Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service
ASTM A 449	(2000) Quenched and Tempered Steel Bolts and Studs
ASTM A 47/A 47M	(1999) Ferritic Malleable Iron Castings
ASTM A 53/A 53M	(2002) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 536	(1984; R 1999e1) Ductile Iron Castings
ASTM A 795	(2000) Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use
ASTM F 436M	(1993; R 2000) Hardened Steel Washers (Metric)

## AMERICAN SOCIETY OF SANITARY ENGINEERING (ASSE)

ASSE 1015	(1999) Double Check Backflow Prevention Assembly
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## AMERICAN WATER WORKS ASSOCIATION(AWWA)

AWWA B300	(1999) Hypochlorites
AWWA B301	(1999) Liquid Chlorine
AWWA C651	(1999) Disinfecting Water Mains
AWWA C652	(1992) Disinfection of Water Storage Facilities

AWWA EWW (1998) Standard Methods for the  
Examination of Water and Wastewater

ASME INTERNATIONAL (ASME)

ASME B16.1 (1998) Cast Iron Pipe Flanges and Flanged  
Fittings

ASME B16.11 (2002) Forged Fittings, Socket-Welding and  
Threaded

ASME B16.21 (1992) Nonmetallic Flat Gaskets for Pipe  
Flanges

ASME B16.9 (2001) Factory-Made Wrought Steel  
Buttwelding Fittings

ASME B18.2.1 (1996) Square and Hex Bolts and Screws  
(Inch Series)

ASME B18.2.2 (1987; R 1999) Square and Hex Nuts (Inch  
Series)

FACTORY MUTUAL ENGINEERING AND RESEARCH (FM)

FM P7825a (2003) Approval Guide Fire Protection

FM P7825b (2003) Approval Guide Electrical Equipment

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS  
INDUSTRY (MSS)

MSS SP-71 (1997) Gray Iron Swing Check Valves,  
Flanges and Threaded Ends

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 101 (2000) Life Safety Code

NFPA 13 (1999) Installation of Sprinkler Systems

NFPA 13D (1999) Installation of Sprinkler Systems  
in One- and Two-Family Dwellings and  
Manufactured Homes Sprinkler Systems

NFPA 13R (1999) Installation of Sprinkler Systems  
in Residential Occupancies Up to and  
Including Four Stories in Height

NFPA 24 (1995) Installation of Private Fire  
Service Mains and Their Appurtenances

NATIONAL INSTITUTE FOR CERTIFICATION IN ENGINEERING TECHNOLOGIES  
(NICET)

NICET 1014-7 (1995) Program Detail Manual for  
Certification in the Field of Fire  
Protection Engineering Technology (Field

Code 003) Subfield of Automatic Sprinkler  
System Layout

## UNDERWRITERS LABORATORIES (UL)

UL Bld Mat Dir (1999) Building Materials Directory

UL Fire Prot Dir (2001) Fire Protection Equipment Directory

## 1.2 GENERAL REQUIREMENTS

Dry pipe sprinkler system shall be provided in areas indicated on the drawings. The sprinkler system shall provide fire sprinkler protection for the entire area. Except as modified herein, the system shall be designed and installed in accordance with NFPA 13. Pipe sizes which are not indicated on the drawings shall be determined by hydraulic calculation. Gridded systems shall not be used. The Contractor shall design any portion of the sprinkler system that are not indicated on the drawings including locating sprinklers, piping, and equipment, and size piping and equipment when this information is not indicated on the drawings or is not specified herein. The design of the sprinkler system shall be based on hydraulic calculations, and the other provisions specified herein.

## 1.2.1 Hydraulic Design

The system shall be hydraulically designed to discharge a minimum density of 8.15 L/min per square meter over the hydraulically most demanding 279 square meters of floor area. Hydraulic calculations shall be provided in accordance with the Area\Density Method of NFPA 13. Water velocity in the piping shall not exceed 6 m/s.

## 1.2.1.1 Hose Demand

An allowance for interior hose stations of 946 L/min shall also be added to the sprinkler system demand.

## 1.2.1.2 Basis for Calculations

The design of the system shall be based upon a water supply with a static pressure of 586 kPa, and a flow of 4921 L/min. at a residual pressure of 483 kPa. Water supply shall be presumed available at the point of connection to existing. Hydraulic calculations shall be based upon the Hazen-Williams formula with a "C" value of 120 for galvanized steel piping, 140 for new cement-lined ductile-iron piping, and 100 for existing underground piping.

## 1.2.2 Sprinkler Coverage

Sprinklers shall be uniformly spaced on branch lines. In buildings protected by automatic sprinklers, sprinklers shall provide coverage throughout 100 percent of the building. This includes, but is not limited to, telephone rooms, electrical equipment rooms, boiler rooms, switchgear rooms, transformer rooms, and other electrical and mechanical spaces. Coverage per sprinkler shall be in accordance with NFPA 13, but shall not exceed 9 square m for extra hazard occupancies, 12 square m for ordinary hazard occupancies, and 21 square m. Exceptions are as follows:

- 1) Facilities that are designed in accordance with NFPA 13R and NFPA 13D.

2) Sprinklers may be omitted from small rooms which are exempted for specific occupancies in accordance with NFPA 101.

#### 1.2.3 System Volume Limitations

Where the volume of any individual system piping volume exceeds 1890 liters the dry pipe valve shall be provided with a quick-opening device. The maximum system capacity controlled by one dry pipe valve shall not exceed 2800 liters. The calculated volume of each system shall be indicated on the Sprinkler System Shop Drawings.

#### 1.3 COORDINATION OF TRADES

Piping offsets, fittings, and any other accessories required shall be furnished as required to provide a complete installation and to eliminate interference with other construction. Sprinkler shall be installed over and under ducts, piping and platforms when such equipment can negatively effect or disrupt the sprinkler discharge pattern and coverage.

#### 1.4 DELIVERY AND STORAGE

All equipment delivered and placed in storage shall be housed in a manner to preclude any damage from the weather, humidity and temperature variations, dirt and dust, or other contaminants. Additionally, all pipes shall either be capped or plugged until installed.

#### 1.5 FIELD MEASUREMENTS

The Contractor shall become familiar with all details of the work, verify all dimensions in the field, and shall advise the Contracting Officer of any discrepancy before performing the work.

#### 1.6 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

##### SD-02 Shop Drawings

Shop Drawings; G, AO.

Three copies of the Sprinkler System Drawings, no later than 21 days prior to the start of sprinkler system installation. The Sprinkler System Drawings shall conform to the requirements established for working plans as prescribed in NFPA 13. Drawings shall include plan and elevation views demonstrating that the equipment will fit the allotted spaces with clearance for installation and maintenance. Each set of drawings shall include the following:

a. Descriptive index of drawings in the submittal with drawings listed in sequence by drawing number. A legend identifying device symbols, nomenclature, and conventions used.

b. Floor plans drawn to a scale not less than 1:100 which

clearly show locations of sprinklers, risers, pipe hangers, seismic separation assemblies, sway bracing, inspector's test connections, drains, and other applicable details necessary to clearly describe the proposed arrangement. Each type of fitting used and the locations of bushings, reducing couplings, and welded joints shall be indicated.

c. Actual center-to-center dimensions between sprinklers on branch lines and between branch lines; from end sprinklers to adjacent walls; from walls to branch lines; from sprinkler feed mains, cross-mains and branch lines to finished floor and roof or ceiling. A detail shall show the dimension from the sprinkler and sprinkler deflector to the ceiling in finished areas.

d. Longitudinal and transverse building sections showing typical branch line and cross-main pipe routing as well as elevation of each typical sprinkler above finished floor.

e. Details of each type of riser assembly; air supply system and piping; pipe hanger; sway bracing for earthquake protection, and restraint of underground water main at point-of-entry into the building, and electrical devices and interconnecting wiring.

#### As-Built Drawings.

As-built shop drawings, at least 14 days after completion of the Final Tests. The Sprinkler System Drawings shall be updated to reflect as-built conditions after all related work is completed and shall be on reproducible full-size mylar film.

#### SD-03 Product Data

##### Fire Protection Related Submittals.

A list of the Fire Protection Related Submittals, no later than 7 days after the approval of the Fire Protection Specialist.

##### Sway Bracing.

For systems that are required to be protected against damage from earthquakes, load calculations for sizing of sway bracing.

##### Materials and Equipment; G, AO.

Manufacturer's catalog data included with the Sprinkler System Drawings for all items specified herein. The data shall be highlighted to show model, size, options, etc., that are intended for consideration. Data shall be adequate to demonstrate compliance with all contract requirements. In addition, a complete equipment list that includes equipment description, model number and quantity shall be provided.

##### Hydraulic Calculations; G, AO.

Hydraulic calculations, including a drawing showing hydraulic reference points and pipe segments.

##### Spare Parts.

Spare parts data for each different item of material and equipment specified.

Preliminary Tests; G, AO.

Proposed procedures for Preliminary Tests, no later than 14 days prior to the proposed start of the tests.

Proposed date and time to begin Preliminary Tests, submitted with the Preliminary Tests Procedures.

Final Acceptance Test; G, AO.

Proposed procedures for Final Acceptance Test, no later than 14 days prior to the proposed start of the tests.

Proposed date and time to begin Final Acceptance Test, submitted with the Final Acceptance Test Procedures. Notification shall be provided at least 14 days prior to the proposed start of the test. Notification shall include a copy of the Contractor's Material & Test Certificates.

Fire Protection Specialist; G, AO.

The name and documentation of certification of the proposed Fire Protection Specialists, no later than 14 days after the Notice to Proceed and prior to the submittal of the sprinkler system shop drawings and hydraulic calculations.

Sprinkler System Installer Qualifications; G, AO.

The name and documentation of certification of the proposed Sprinkler System Installer, concurrent with submittal of the Fire Protection Specialist Qualifications.

Onsite Training; G, AO.

Proposed On-site Training schedule, at least 14 days prior to the start of related training.

#### SD-06 Test Reports

Preliminary Tests; G, AO.

Three copies of the completed Preliminary Tests Reports, no later than 7 days after the completion of the Preliminary Tests. The Preliminary Tests Report shall include both the Contractor's Material and Test Certificate for Underground Piping and the Contractor's Material and Test Certificate for Aboveground Piping. All items in the Preliminary Tests Report shall be signed by the Fire Protection Specialist.

Final Acceptance Test; G, AO.

Three copies of the completed Final Acceptance Tests Reports, no later than 7 days after the completion of the Final Acceptance Tests. All items in the Final Acceptance Report shall be signed by the Fire Protection Specialist.

## SD-07 Certificates

Inspection by Fire Protection Specialist; G, AO.

Concurrent with the Final Acceptance Test Report, certification by the Fire Protection Specialist that the sprinkler system is installed in accordance with the contract requirements, including signed approval of the Preliminary and Final Acceptance Test Reports.

## SD-10 Operation and Maintenance Data

Operating and Maintenance Instructions.

Six manuals listing step-by-step procedures required for system startup, operation, shutdown, and routine maintenance, at least 14 days prior to field training. The manuals shall include the manufacturer's name, model number, parts list, list of parts and tools that should be kept in stock by the owner for routine maintenance including the name of a local supplier, simplified wiring and controls diagrams, troubleshooting guide, and recommended service organization (including address and telephone number) for each item of equipment.

## 1.7 HYDRAULIC CALCULATIONS

Hydraulic calculations shall be as outlined in NFPA 13 except that calculations shall be performed by computer using software intended specifically for fire protection system design using the design data shown on the drawings. Software that uses k-factors for typical branch lines is not acceptable. Calculations shall be based on the water supply data shown on the drawings. Calculations shall substantiate that the design area used in the calculations is the most demanding hydraulically. Water supply curves and system requirements shall be plotted on semi-logarithmic graph paper so as to present a summary of the complete hydraulic calculation. A summary sheet listing sprinklers in the design area and their respective hydraulic reference points, elevations, actual discharge pressures and actual flows shall be provided. Elevations of hydraulic reference points (nodes) shall be indicated. Documentation shall identify each pipe individually and the nodes connected thereto. The diameter, length, flow, velocity, friction loss, number and type fittings, total friction loss in the pipe, equivalent pipe length and Hazen-Williams coefficient shall be indicated for each pipe. For gridded systems, calculations shall show peaking of demand area friction loss to verify that the hydraulically most demanding area is being used. Also for gridded systems, a flow diagram indicating the quantity and direction of flows shall be included. A drawing showing hydraulic reference points (nodes) and pipe designations used in the calculations shall be included and shall be independent of shop drawings.

## 1.8 FIRE PROTECTION SPECIALIST

Work specified in this section shall be performed under the supervision of and certified by the Fire Protection Specialist. The Fire Protection Specialist shall be an individual who is a registered professional engineer and a Full Member of the Society of Fire Protection Engineers or who is certified as a Level III Technician by National Institute for Certification in Engineering Technologies (NICET) in the Automatic Sprinkler System Layout subfield of Fire Protection Engineering Technology in accordance

with NICET 1014-7. The Fire Protection Specialist shall be regularly engaged in the design and installation of the type and complexity of system specified in the Contract documents, and shall have served in a similar capacity for at least three systems that have performed in the manner intended for a period of not less than 6 months.

#### 1.9 SPRINKLER SYSTEM INSTALLER QUALIFICATIONS

Work specified in this section shall be performed by the Sprinkler System Installer. The Sprinkler System Installer shall be regularly engaged in the installation of the type and complexity of system specified in the Contract documents, and shall have served in a similar capacity for at least three systems that have performed in the manner intended for a period of not less than 6 months.

#### 1.10 REGULATORY REQUIREMENTS

Compliance with referenced NFPA standards is mandatory. This includes advisory provisions listed in the appendices of such standards, as though the word "shall" had been substituted for the word "should" wherever it appears. In the event of a conflict between specific provisions of this specification and applicable NFPA standards, this specification shall govern. Reference to "authority having jurisdiction" shall be interpreted to mean the Contracting Officer.

#### 1.11 SPARE PARTS

The Contractor shall submit spare parts data for each different item of material and equipment specified. The data shall include a complete list of parts and supplies, with current unit prices and source of supply, and a list of parts recommended by the manufacturer to be replaced after 1 year and 3 years of service. A list of special tools and test equipment required for maintenance and testing of the products supplied by the Contractor shall be included.

### PART 2 PRODUCTS

#### 2.1 STANDARD PRODUCTS

Materials and equipment shall be standard products of a manufacturer regularly engaged in the manufacture of such products and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening.

#### 2.2 NAMEPLATES

All equipment shall have a nameplate that identifies the manufacturer's name, address, type or style, model or serial number, and catalog number.

#### 2.3 REQUIREMENTS FOR FIRE PROTECTION SERVICE

Materials and Equipment shall have been tested by Underwriters Laboratories, Inc. and listed in UL Fire Prot Dir or approved by Factory Mutual and listed in FM P7825a and FM P7825b. Where the terms "listed" or "approved" appear in this specification, such shall mean listed in UL Fire Prot Dir or FM P7825a and FM P7825b.

#### 2.4 ABOVEGROUND PIPING COMPONENTS



#### 2.4.1 Steel Pipe

Except as modified herein, steel pipe shall be galvanized conforming to the applicable requirements of NFPA 13, and ASTM A 795, ASTM A 53/A 53M, or ASTM A 135. Pipe in which threads or grooves are cut shall be Schedule 40 or shall be listed by Underwriters' Laboratories to have a corrosion resistance ratio (CRR) of 1.0 or greater after threads or grooves are cut. Pipe shall be marked with the name of the manufacturer, kind of pipe, and ASTM designation.

#### 2.4.2 Fittings for Non-Grooved Steel Pipe

Fittings shall be galvanized steel conforming to ASME B16.9 or ASME B16.11.

Fittings that sprinklers, drop nipples or riser nipples (sprigs) are screwed into shall be threaded type. Plain-end fittings with mechanical couplings, fittings that use steel gripping devices to bite into the pipe and segmented welded fittings shall not be used.

#### 2.4.3 Grooved Mechanical Joints and Fittings

Joints and fittings shall be designed for not less than 1200 kPa service and shall be the product of the same manufacturer; segmented welded fittings shall not be used. Fitting and coupling houses shall be malleable iron conforming to ASTM A 47/A 47M, Grade 32510; ductile iron conforming to ASTM A 536, Grade 65-45-12. Gaskets shall be of silicon compound and approved for dry fire protection systems. Gasket shall be the flush type that fills the entire cavity between the fitting and the pipe. Nuts and bolts shall be heat-treated steel conforming to ASTM A 183 and shall be cadmium plated or zinc electroplated.

#### 2.4.4 Flanges

Flanges shall conform to NFPA 13 and ASME B16.1. Gaskets shall be non-asbestos compressed material in accordance with ASME B16.21, 1.6 mm (1/16 inch) thick, and full face or self-centering flat ring type.

##### 2.4.4.1 Bolts

Bolts shall be squarehead conforming to ASME B18.2.1 or ASTM A 449, Type 1 and shall extend no less than three full threads beyond the nut with bolts tightened to the required torque.

##### 2.4.4.2 Nuts

Nuts shall be hexagon type conforming to ASME B18.2.2 or ASTM A 193/A 193M, Grade 5.

##### 2.4.4.3 Washers

Washers shall meet the requirements of ASTM F 436M. Flat circular washers shall be provided under all bolt heads and nuts.

#### 2.4.5 Pipe Hangers

Hangers shall be listed in UL Fire Prot Dir or FM P7825a and FM P7825b and of the type suitable for the application, construction, and pipe type and size to be supported.

#### 2.4.6 Valves

#### 2.4.6.1 Control Valve and Gate Valve

Manually operated sprinkler control valve and gate valve shall be outside stem and yoke (OS&Y) type and shall be listed in UL Bld Mat Dir or FM P7825a and FM P7825b.

#### 2.4.6.2 Check Valve

Check valve 50 mm and larger shall be listed in UL Bld Mat Dir or FM P7825a and FM P7825b. Check valves 100 mm and larger shall be of the swing type with flanged cast iron body and flanged inspection plate, shall have a clear waterway and shall meet the requirements of MSS SP-71, for Type 3 or 4.

### 2.5 DRY PIPE VALVE ASSEMBLY

The dry pipe valve shall be a latching differential type listed in UL Fire Prot Dir or FM P7825a and FM P7825b and shall be complete with trim piping, valves, fittings, pressure gauges, priming water fill cup, velocity drip check, drip cup, and other ancillary components as required for proper operation. The assembly shall include a quick-opening device by the same manufacturer as the dry pipe valve for systems over 1890 liters in capacity.

### 2.6 SUPERVISORY AIR SYSTEM

Air supply system shall be in accordance with NFPA 13. The connection pipe from the air compressor shall not be less than 15 mm in diameter and shall enter the system above the priming water level of the dry pipe valve. A check valve shall be installed in the system supply air piping from the compressor. A shutoff valve of the renewable disc type shall be installed upstream of this check valve. The air supply system shall be sized to pressurize the sprinkler system to 275 kPa within 20 minutes.

#### 2.6.1 Air Compressor

Compressor shall be single stage oil-free type, air-cooled, electric-motor driven, equipped with a check valve, shutoff valve and pressure switch for automatic starting and stopping. Pressure switch shall be factory set to start the compressor at 200 kPa and stop it at 300 kPa. A safety relief valve, set to operate at 450 kPa, shall be provided.

#### 2.6.2 Air Pressure Maintenance Device

Device shall be a pressure regulator that automatically reduces supply air to provide the pressure required to be maintained in the piping system. The device shall have a cast bronze body and valve housing complete with diaphragm assembly, spring, filter, ball check to prevent backflow, 1.6 mm restriction to prevent rapid pressurization of the system, and adjustment screw. The device shall be capable of reducing an inlet pressure of up to 680 kPa to a fixed outlet pressure adjustable to 70 kPa.

#### 2.6.3 Air Supply Piping System

System shall be configured so that each dry pipe system is equipped with a separate pressure maintenance device, air compressor, shutoff valve, bypass valve and pressure gauge. Piping shall be galvanized steel in accordance with ASTM A 795 or ASTM A 53/A 53M.

#### 2.6.4 Low Air Pressure Alarm Device

Each dry pipe valve trim shall be provided with a local alarm device consisting of a metal enclosure containing an alarm horn or bell, silence switch, green power-on light, red low-air alarm light and amber trouble light. The alarm device shall be activated by the low air pressure switch. Upon reduction of sprinkler system pressure to approximately 70 kPa above the dry valve trip point pressure, the low air pressure switch shall actuate the audible alarm device and a red low-air alarm light. Restoration of system pressure shall cause the low-air alarm light to be extinguished and the audible alarm to be silenced. An alarm silence switch shall be provided to silence the audible alarm. An amber trouble light shall be provided which will illuminate upon operation of the silence switch and shall be extinguished upon return to its normal position.

#### 2.7 WATERFLOW ALARM

Electrically operated, exterior-mounted, waterflow alarm bell shall be provided and installed in accordance with NFPA 13. Waterflow alarm bell shall be rated 24 VDC and shall be connected to the Fire Alarm Control Panel(FACP) in accordance with Section 13851 FIRE DETECTION AND ALARM SYSTEM, ADDRESSABLE

#### 2.8 ALARM INITIATING AND SUPERVISORY DEVICES

##### 2.8.1 Sprinkler Pressure (Waterflow) Alarm Switch

Pressure switch shall include a metal housing with a neoprene diaphragm, SPDT snap action switches and a 15 mm NPT male pipe thread. The switch shall have a maximum service pressure rating of 1207 kPa. There shall be two SPDT (Form C) contacts factory adjusted to operate at 28 to 55 kPa. The switch shall be capable of being mounted in any position in the alarm line trim piping of the dry pipe valve.

##### 2.8.2 Low Air Pressure Supervisory Switch

The pressure switch shall supervise the air pressure in system and shall be set to activate at 70 kPa above the dry pipe valve trip point pressure. The switch shall have an adjustable range between 35 kPa and 500 kPa. The switch shall have screw terminal connection and shall be capable of being wired for normally open or normally closed circuit.

##### 2.8.3 Valve Supervisory (Tamper) Switch

Switch shall be suitable for mounting to the type of control valve to be supervised open. The switch shall be tamper resistant and contain one set of SPDT (Form C) contacts arranged to transfer upon removal of the housing cover or closure of the valve of more than two rotations of the valve stem.

#### 2.9 FIRE DEPARTMENT CONNECTION

Fire department connection shall be provided per Section 13931.

#### 2.10 SPRINKLERS

Sprinklers with internal O-rings shall not be used. Sprinklers shall be used in accordance with their listed coverage limitations. Areas where sprinklers are connected to or are a part of the dry pipe system shall be considered unheated and subject to freezing. Temperature classification

shall be ordinary. Sprinklers in high heat areas including attic spaces or in close proximity to unit heaters shall have temperature classification in accordance with NFPA 13. Extended coverage sprinklers shall not be used.

#### 2.10.1 Upright Sprinkler

Upright sprinkler shall be brass and shall have a nominal 12.7 mm orifice.

#### 2.11 DISINFECTING MATERIALS

##### 2.11.1 Liquid Chlorine

Liquid chlorine shall conform to AWWA B301.

##### 2.11.2 Hypochlorites

Calcium hypochlorite and sodium hypochlorite shall conform to AWWA B300.

#### 2.12 ACCESSORIES

##### 2.12.1 Sprinkler Cabinet

Spare sprinklers shall be provided in accordance with NFPA 13 and shall be packed in a suitable metal or plastic cabinet. Spare sprinklers shall be representative of, and in proportion to, the number of each type and temperature rating of the sprinklers installed. At least one wrench of each type required shall be provided.

##### 2.12.2 Pipe Escutcheon

Escutcheon shall be polished chromium-plated zinc alloy, or polished chromium-plated copper alloy. Escutcheons shall be either one-piece or split-pattern, held in place by internal spring tension or set screw.

##### 2.12.3 Sprinkler Guard

Guard shall be a steel wire cage designed to encase the sprinkler and protect it from mechanical damage. Guards shall be provided on sprinklers subject to damage.

##### 2.12.4 Identification Sign

Valve identification sign shall be minimum 150 mm wide by 50 mm high with enamel baked finish on minimum 1.214 mm steel or 0.6 mm aluminum with red letters on a white background or white letters on red background. Wording of sign shall include, but not be limited to "main drain," "auxiliary drain," "inspector's test," "alarm test," "alarm line," and similar wording as required to identify operational components.

#### 2.13 DOUBLE-CHECK VALVE BACKFLOW PREVENTION ASSEMBLY

Double-check backflow prevention assembly shall comply with ASSE 1015. The assembly shall have a bronze, cast-iron or stainless steel body with flanged ends. The assembly shall include pressure gauge test ports and OS&Y shutoff valves on the inlet and outlet, 2-positive-seating check valve for continuous pressure application, and four test cocks. Assemblies shall be rated for working pressure of 1034 kPa. The maximum pressure loss shall be 40 kPa at a flow rate equal to the sprinkler water demand, at the location of the assembly. A test port for a pressure gauge shall be

provided both upstream and downstream of the double check backflow prevention assembly valves.

### PART 3 EXECUTION

#### 3.1 FIRE PROTECTION RELATED SUBMITTALS

The Fire Protection Specialist shall prepare a list of the submittals from the Contract Submittal Register that relate to the successful installation of the sprinkler systems(s). The submittals identified on this list shall be accompanied by a letter of approval signed and dated by the Fire Protection Specialist when submitted to the Government.

#### 3.2 INSTALLATION REQUIREMENTS

The installation shall be in accordance with the applicable provisions of NFPA 13, NFPA 24 and publications referenced therein.

#### 3.3 INSPECTION BY FIRE PROTECTION SPECIALIST

The Fire Protection Specialist shall inspect the sprinkler system periodically during the installation to assure that the sprinkler system installed in accordance with the contract requirements. The Fire Protection Specialist shall witness the preliminary and final tests, and shall sign the test results. The Fire Protection Specialist, after completion of the system inspections and a successful final test, shall certify in writing that the system has been installed in accordance with the contract requirements. Any discrepancy shall be brought to the attention of the Contracting Officer in writing, no later than three working days after the discrepancy is discovered.

#### 3.4 ABOVEGROUND PIPING INSTALLATION

##### 3.4.1 Protection of Piping Against Earthquake Damage

The system piping shall be protected against damage from earthquakes. Seismic protection shall include flexible and rigid couplings, sway bracing, seismic separation assemblies where piping crosses building seismic separation joints, and other features as required by NFPA 13 for protection of piping against damage from earthquakes.

##### 3.4.2 Piping in Exposed Areas

Exposed piping shall be installed so as not diminish exit access widths, corridors, or equipment access. Exposed horizontal piping, including drain piping, shall be installed to provide maximum headroom.

##### 3.4.3 Piping in Finished Areas

In areas with suspended or dropped ceilings and in areas with concealed spaces above the ceiling, piping shall be concealed above ceilings. Piping shall be inspected, tested and approved before being concealed. Risers and similar vertical runs of piping in finished areas shall be concealed.

##### 3.4.4 Upright Sprinklers

Riser nipples or "sprigs" to upright sprinklers shall contain no fittings between the branch line tee and the reducing coupling at the sprinkler. Riser nipples exceeding 750 mm in length shall be individually supported.

### 3.4.5 Pipe Joints

Pipe joints shall conform to NFPA 13, except as modified herein. Not more than four threads shall show after joint is made up. Welded joints will be permitted, only if welding operations are performed as required by NFPA 13 at the Contractor's fabrication shop, not at the project construction site.

Flanged joints shall be provided where indicated or required by NFPA 13. Grooved pipe and fittings shall be prepared in accordance with the manufacturer's latest published specification according to pipe material, wall thickness and size. Grooved couplings and fittings shall be from the same manufacturer. Grooved joints shall not be used in concealed locations, such as behind solid walls or ceilings, unless an access panel is shown on the drawings for servicing or adjusting the joint.

### 3.4.6 Reducers

Reductions in pipe sizes shall be made with one-piece tapered reducing fittings. The use of grooved-end or rubber-gasketed reducing couplings will not be permitted. When standard fittings of the required size are not manufactured, single bushings of the face type will be permitted. Where used, face bushings shall be installed with the outer face flush with the face of the fitting opening being reduced. Bushings shall not be used in elbow fittings, in more than one outlet of a tee, in more than two outlets of a cross, or where the reduction in size is less than 15 mm.

### 3.4.7 Pipe Penetrations

Cutting structural members for passage of pipes or for pipe-hanger fastenings will not be permitted. Pipes that must penetrate concrete or masonry walls or concrete floors shall be core-drilled and provided with pipe sleeves. Each sleeve shall be Schedule 40 galvanized steel, ductile iron or cast iron pipe and shall extend through its respective wall or floor and be cut flush with each wall surface. Sleeves shall provide required clearance between the pipe and the sleeve per NFPA 13. The space between the sleeve and the pipe shall be firmly packed with mineral wool insulation. Where pipes penetrate fire walls, fire partitions, or floors, pipes shall be fire stopped in accordance with Section 07840 FIRESTOPPING. In penetrations that are not fire-rated or not a floor penetration, the space between the sleeve and the pipe shall be sealed at both ends with plastic waterproof cement that will dry to a firm but pliable mass or with a mechanically adjustable segmented elastomer seal.

### 3.4.8 Escutcheons

Escutcheons shall be provided for pipe penetration of ceilings and walls. Escutcheons shall be securely fastened to the pipe at surfaces through which piping passes.

### 3.4.9 Inspector's Test Connection

Unless otherwise indicated, test connection shall consist of 25 mm pipe connected at the riser as a combination test and drain valve; a test valve located approximately 2 meters above the floor; a smooth bore brass outlet equivalent to the smallest orifice sprinkler used in the system; and a painted metal identification sign affixed to the valve with the words "Inspector's Test." The discharge orifice shall be located outside the building wall directed so as not to cause damage to adjacent construction or landscaping during full flow discharge.

### 3.4.10 Drains

Main drain piping shall be provided to discharge at a safe point outside the building. Auxiliary drains shall be provided as indicated and as required by NFPA 13. When the capacity of trapped sections of pipe is less than 11 liters, the auxiliary drain shall consist of a valve not smaller than 15 mm and a plug or nipple and cap. When the capacity of trapped sections of piping is more than 11 liters, the auxiliary drain shall consist of two 25 mm valves and one 50 x 300 mm condensate nipple or equivalent, located in an accessible location. Tie-in drains shall be provided for multiple adjacent trapped branch pipes and shall be a minimum of 25 mm in diameter. Tie-in drain lines shall be pitched a minimum of 15 mm per 3 mm.

### 3.4.11 Identification Signs

Signs shall be affixed to each control valve, inspector test valve, main drain, auxiliary drain, test valve, and similar valves as appropriate or as required by NFPA 13. Hydraulic design data nameplates shall be permanently affixed to each sprinkler riser as specified in NFPA 13.

## 3.5 ELECTRICAL WORK

Except as modified herein, electric equipment and wiring shall be in accordance with Section 16415 ELECTRICAL WORK, INTERIOR. Alarm signal wiring connected to the building fire alarm control system shall be in accordance with Section 13851 FIRE DETECTION AND ALARM SYSTEM, ADDRESSABLE. Wiring color code shall remain uniform throughout the system.

## 3.6 DISINFECTION

After all system components are installed and hydrostatic test(s) are successfully completed, each portion of the sprinkler system to be disinfected shall be thoroughly flushed with potable water until all entrained dirt and other foreign materials have been removed before introducing chlorinating material. Flushing shall be conducted by removing the flushing fitting of the cross mains and of the grid branch lines, and then back-flushing through the sprinkler main drains. The chlorinating material shall be hypochlorites or liquid chlorine. Water chlorination procedure shall be in accordance with AWWA C651 and AWWA C652. The chlorinating material shall be fed into the sprinkler piping at a constant rate of 50 parts per million (ppm). A properly adjusted hypochlorite solution injected into the system with a hypochlorinator, or liquid chlorine injected into the system through a solution-fed chlorinator and booster pump shall be used. Chlorination application shall continue until the entire system is filled. The water shall remain in the system for a minimum of 24 hours. Each valve in the system shall be opened and closed several times to ensure its proper disinfection. Following the 24-hour period, no less than 25 ppm chlorine residual shall remain in the system. The system shall then be flushed with clean water until the residual chlorine is reduced to less than one part per million. Samples of water in disinfected containers for bacterial examination will be taken from several system locations which are approved by the Contracting Officer. Samples shall be tested for total coliform organisms (coliform bacteria, fecal coliform, streptococcal, and other bacteria) in accordance with AWWA EWW. The testing method shall be either the multiple-tube fermentation technique or the membrane-filter technique. The disinfection shall be repeated until tests indicate the absence of coliform organisms (zero mean coliform

density per 100 milliliters) in the samples for at least 2 full days. The system will not be accepted until satisfactory bacteriological results have been obtained. After the successful completion, all sprinklers or plugs and gravity flush all drops or trapped piping.

### 3.7 PIPE COLOR CODE MARKING

Color code marking of piping shall be as specified in Section 09900 PAINTS AND COATINGS.

### 3.8 PRELIMINARY TESTS

The system, including the underground water mains, and the aboveground piping and system components, shall be tested to assure that equipment and components function as intended. The underground and aboveground interior piping systems and attached appurtenances subjected to system working pressure shall be tested in accordance with NFPA 13 and NFPA 24. Upon completion of specified tests, the Contractor shall complete certificates as specified in paragraph SUBMITTALS.

#### 3.8.1 Aboveground Piping

##### 3.8.1.1 Hydrostatic Testing

Aboveground piping shall be hydrostatically tested in accordance with NFPA 13 at not less than 1400 kPa or 350 kPa in excess of maximum system operating pressure and shall maintain that pressure without loss for 2 hours. There shall be no drop in gauge pressure or visible leakage when the system is subjected to the hydrostatic test. The test pressure shall be read from a gauge located at the low elevation point of the system or portion being tested.

##### 3.8.1.2 Air Pressure Test

As specified in NFPA 13, an air pressure leakage test at 350 kPa shall be conducted for 24 hours. There shall be no drop in gauge pressure in excess of 10 kPa for the 24 hours. This air pressure test is in addition to the required hydrostatic test.

#### 3.8.2 Testing of Alarm Devices

Each alarm initiating device, including pressure alarm switch, low air pressure switch, valve supervisory switch, and electrically-operated switch shall be tested for proper operation. Water motor alarm shall be tested. The connecting circuit to the building fire alarm system shall be inspected and tested.

#### 3.8.3 Trip Tests of Dry Pipe Valves

Each dry pipe valve shall be trip-tested by reducing normal system air pressure through operation the inspector's test connection. Systems equipped with quick opening devices shall be first tested without the operation of the quick opening device and then with it in operation. Test results will be witnessed and recorded. Test results shall include the number of seconds elapsed between the time the test valve is opened and tripping of the dry valve; trip-point air pressure of the dry pipe valve; water pressure prior to valve tripping; and number of seconds elapsed between time the inspector's test valve is opened and water reaches the orifice.



#### 3.8.4 Main Drain Flow Test

Following flushing of the underground piping, a main drain test shall be made to verify the adequacy of the water supply. Static and residual pressures shall be recorded on the certificate specified in paragraph SUBMITTALS. In addition, a main drain test shall be conducted each time after a main control valve is shut and opened.

#### 3.9 FINAL ACCEPTANCE TEST

Final Acceptance Test shall begin only when the Preliminary Test Report has been approved. The Fire Protection Specialist shall conduct the Final Acceptance Test and shall provide a complete demonstration of the operation of the system. This shall include operation of control valves and flowing of inspector's test connections to verify operation of associated waterflow alarm switches. After operation of control valves has been completed, the main drain test shall be repeated to assure that control valves are in the open position. Each system shall be completely drained after each trip test. The system air supply system shall be tested to verify that system pressure is restored in the specified time. In addition, the Fire Protection Specialist shall have available copies of as-built drawings and certificates of tests previously conducted. The installation shall not be considered accepted until identified discrepancies have been corrected and test documentation is properly completed and received. After the system has been tested and drained, the system shall be drained periodically for at least 2 weeks until it can be assured that water from the system has been removed.

#### 3.10 ONSITE TRAINING

The Fire Protection Specialist and Manufacturer's Representative shall conduct a training course for operating and maintenance personnel as designated by the Contracting Officer. Training shall be provided for a period of 4 hours of normal working time and shall start after the system is functionally complete but prior to the Preliminary Tests and Final Acceptance Test. The Onsite Training shall cover all of the items contained in the approved Operating and Maintenance Instructions.

-- End of Section --

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## SECTION 14240

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## SECTION 14240

## HYDRAULIC ELEVATORS

**09/02**

## PART 1 GENERAL

## 1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

## ASME INTERNATIONAL (ASME)

ASME A17.1	(2002) Safety Code for Elevators and Escalators
ASME A17.2.2	(1997) Inspector's Manual for Hydraulic Elevators
ASME B16.9	(2001) Factory-Made Wrought Steel Buttwelding Fittings
ASME B16.11	(2001) Forged Fittings, Socket-Welding and Threaded

## ASTM INTERNATIONAL (ASTM)

ASTM A 53/A 53M	(2001) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 106	(1999e1) Seamless Carbon Steel Pipe for High-Temperature Service
ASTM D 92	(2001) Flash and Fire Points by Cleveland Open Cup
ASTM D 97	(1996a) Pour Point of Petroleum Products

## U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

36 CFR 1191	(1998) ADA Accessibility Guidelines for - Buildings and Facilities
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## AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M	(2000) Structural Welding Code - Steel
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## NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG 1	(1998) Motors and Generators
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## NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70

(2002) National Electrical Code

## 1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

## SD-02 Shop Drawings

Detail Drawings; G, AE.

Detail drawings including dimensioned layouts in plan and elevation showing the arrangement of elevator equipment, accessories, supporting systems, anchorage of equipment, clearances for maintenance and operation; and details on hoistway, doors and frames, operation and signal stations, controllers, motors, guide rails and brackets, cylinder and plunge unit, and points of interface with normal power fire alarm system. Drawings shall show any revised building electrical system required to make supplied elevator system function as specified. Drawings shall contain complete wiring diagrams showing electrical connections and other details required to demonstrate sequence of operations and functions of system devices. Drawings shall include the appropriate sizing of electrical protective devices which are frequently different from National Electrical Code standard sizes.

Submit one set of wiring diagrams in plastic or glass cover, framed and mounted in elevator machine room. Deliver other sets to Contracting Officer. Coded diagrams are not acceptable unless adequately identified.

## SD-03 Product Data

Passenger Elevators; G, AE.

Include information on motor, pump, gages, piston and cylinder, piping and valves, hall station, and buffer on elevators and accessories. For elevator supporting systems, include information on car control and emergency power systems. On data sheets, provide document identification number or bulletin number, published or copyrighted prior to the date of contract bid opening.

Field Quality Control; G, AO.

A plan detailing the testing procedures shall be submitted 60 days prior to performing the elevator tests.

Logic Control; G, AE.

Microprocessor control system, including appropriate hardware and software and other specified requirements.

## SD-05 Design Data

Reaction Loads; G, AE.

Calculations of reaction loads imposed on building by elevator system that comply with ASME A17.1. Calculations shall be certified by a Registered Professional Engineer. Do not fabricate materials nor perform construction until approved by Contracting Officer.

Heat Loads; G, AE.

Calculations for total anticipated heat loads generated by all the elevator machine room equipment. Calculations shall be certified by a Registered Professional Engineer. Do not fabricate materials nor perform construction until approved by the Contracting Officer.

#### SD-06 Test Reports

Field Tests Reports; G, AO.

Test reports in booklet form showing all field tests performed to adjust each component and all field tests performed to prove compliance with the specified performance criteria, upon completion and testing of installed system shall be submitted 14 days after the successful completion of testing.

#### SD-07 Certificates

Qualifications; G, AO.

A letter no later than 14 days after the Notice to Proceed providing the name and Statement of Qualifications, including ASME A17.1 Certificate and all required state and local licenses of the individual who will perform the duties specified herein for the Elevator Inspector. A letter of endorsement from the elevator manufacturer certifying that the Elevator Specialist is acceptable to manufacturer no later than 14 days after the Notice to Proceed providing the name and Statement of Qualifications of the individual who will perform the duties specified herein for the Elevator Specialist. Copies of certified welders' qualifications, demonstrating compliance with AWS D1.1/D1.1M, Section 5; list welders' names with corresponding code marks.

#### SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals; G, AO.  
Maintenance and Diagnostic Tools; G, AO.  
Maintenance and Repair Action Plan; G, AO.

Submit data package in accordance with Section 01781 OPERATION AND MAINTENANCE DATA. Three Operation and Maintenance Manuals, submitted 28 days prior to the Operation and Maintenance Training. Include a list of phone numbers, personnel contacts, and all tools required for operation and maintenance.

Operation and Maintenance Training; G, AO.

Proposed Onsite Training schedule, submitted concurrently with the



## Operation and Maintenance Manuals.

## 1.3 ELEVATOR SYSTEM

Provide pre-engineered elevator system by manufacturer regularly engaged in the manufacture of elevator systems and that complies with ASME A17.1 in its entirety, ASME A17.2.2 in its entirety, and additional requirements specified herein. The Contractor shall submit: 1) Detail Drawings as required in the Submittals paragraph; 2) calculations for the Reaction Loads imposed on the building by and 3) Heat Loads generated by the elevator system.

## 1.4 QUALIFICATIONS

## 1.4.1 Elevator Specialist

Work specified in this section shall be performed under the direct guidance of the Elevator Specialist. The Elevator Specialist shall be regularly engaged in the installation and maintenance of the type and complexity of elevator system specified in the Contract documents, and shall have served in a similar capacity for at least three systems that have performed in the manner intended for a period of not less than 24 months. Elevator system manufacturer shall provide letter of endorsement from the elevator manufacturer certifying that the Elevator Specialist is acceptable to manufacturer. The Elevator Specialist shall oversee the acceptance inspections and tests, and shall sign and certify the successful results. The Elevator Specialist, after completion of the acceptance inspections and tests, shall certify in writing that the installation is in accordance with the contract requirements. Any discrepancy shall be brought to the attention of the Contracting Officer in writing, no later than three working days after the discrepancy is discovered.

## 1.4.2 Elevator Inspector

1) The Elevator Inspector shall be certified in accordance with the requirements of ASME A17.1. The Certified Elevator Inspector shall inspect the installation of the elevator(s) to assure that the installation conforms with all contract requirements. The Elevator Inspector shall be directly employed by the Prime Contractor and be independent of the Elevator System Manufacturer and the Elevator Specialist and shall witness the acceptance inspections and tests, shall approve all results and shall sign and certify the successful results. The Elevator Inspector, after completion of the acceptance inspections and tests, shall certify in writing that the installation is in accordance with the contract requirements. Any discrepancy shall be brought to the attention of the Contracting Officer in writing, no later than three working days after the discrepancy is discovered.

## 1.4.3 Welders' Qualifications

Comply with AWS D1.1/D1.1M, Part 4 Qualifications. Provide certified copies of welders' qualifications. List welders' names with corresponding code marks to identify each welder's work.

## 1.5 NEW INSTALLATION SERVICE

Provide routine warranty service in accord with manufacturer's warranty requirements, for period of 12 months after date of acceptance by Contracting Officer. Include 24-hour emergency service, with 1 hour

response time, during this period without additional cost to Government. Include adjustments, greasing, oiling, and cleaning. Provide routine inspection and tests of elevators in accordance with ASME A17.1 Section 8.11.3 and ASME A17.2.2. Provide supplies and parts to keep elevator system in operation. Perform service only by factory trained personnel.

#### 1.5.1 Special Operations

Test systems for Firefighters' Service. Schedule to not interfere with building operations. For Firefighters' Service, test monthly in accordance with ASME A17.1, Section 8.6.10.1. Provide written results of each test operation to the Contracting Officer.

#### 1.5.2 Documentation

Document all inspection and testing. Maintain copy of documentation in machine room.

#### 1.5.3 Maintenance and Diagnostic Tools

Provide all special tools and software necessary to service and maintain each elevator; deliver at time of final acceptance. Provide one of each tool per group of elevators. Include solid state or microprocessor diagnostic tools if unavailable on the open market. Provide necessary diagnostic software where the solid state or microprocessor diagnostic tools are available on the open market.

#### 1.5.4 Keys for Elevator Key Switches

Provide minimum of twelve keys per unique cylinder used on all key switches for single elevator. If more than one elevator, additional keys not required unless there are additional unique cylinders. Keys shall be provided with brass or fiberglass tags marked 'PROPERTY OF THE U. S. GOVERNMENT' on one side with function of key or approved code number on other side.

### 1.6 FIRE PROTECTION SYSTEM

Fire protection system shall be in accordance with Section 13851 INTERIOR FIRE DETECTION AND ALARM SYSTEM, ADDRESSABLE. Additional fire protection requirements found in Section 13930 WET PIPE SPRINKLER SYSTEM, FIRE PROTECTION will apply as directed by the Contracting Officer.

### 1.7 MAINTENANCE AND REPAIR ACTION PLAN

Provide plan of action prepared by the Elevator Specialist to provide emergency and routine maintenance in accordance with paragraph titled NEW INSTALLATION SERVICE. Provide a list of phone numbers, personnel contacts, and all tools to the Contracting Officer.

## PART 2 PRODUCTS

### 2.1 PASSENGER ELEVATORS

#### 2.1.1 Basic Requirements - Elevator 1

- a. Rated Load: 1134 kg (2500 lb)
- b. Rated Speed: 0.64 mps (125 F/S)

- c. Travel Length: 9.7 m (32 feet)
- d. Number of Stops: 3.
- e. Number of Hoist Way Openings: 2 Front; 1 Rear
- f. Platform Dimensions: 2134 mm wide, 1524 mm deep and 2438 mm high
- g. Car Door Opening: 1067 mm wide and 2134 mm high
- h. Car Door Type: Single-speed center opening Horizontal sliding.
- i. Drive Type: In-ground hydraulic, single jack.

#### 2.1.2 Basic Requirements - Elevator 2

- a. Rated Load: 907 kg (2000 lb)
- b. Rated Speed: 0.64 mps (125 F/S)
- c. Travel Length: 4.9 m (16 feet)
- d. Number of Stops: 2.
- e. Number of Hoist Way Openings: 1 Front
- f. Platform Dimensions: 1829 mm wide, 1524 mm deep and 2438 mm high
- g. Car Door Opening: 914 mm wide and 2134 mm high
- h. Car Door Type: Single speed side slide, Horizontal sliding.
- i. Drive Type: Hydraulic, dual-jack, single-stage, hole-less type.

#### 2.1.3 Cab Enclosures and Door Finishes

Provide finishes as indicated.

- a. Floor; carpet.
- b. Walls; laminated plastic on particleboard; color as indicated.  
Provide each cab wall with equally spaced and equally sized wall panels. All fasteners shall be concealed.  
Wall trim; stainless steel.  
Accessories; hand rails stainless steel.
- c. Interior face of door(s); stainless steel.
- d. Ceilings; Plastic Laminate surface with metallic-silver reveals with mirror finish. Provide six recessed 20 watt, low voltage, halogen lights with round chrome trim. Light level shall be at least 10 foot candles at the threshold with the door closed.  
Provide laminate finish in color indicated.
- e. Hoistway Doors and Frame Finishes

Provide finishes on exterior of hoistway as follows:

- (1) Frame; stainless steel.
- (2) Exterior face of door; stainless steel.

## 2.2 SPECIAL OPERATION AND CONTROL

Provide all special operations and control systems in accordance with ASME A17.1. Provide special operation key switches with 6 pin cylinder locks with removable cores. Provide a key control lock for each operation system.

### 2.2.1 Firefighters' Service

Provide equipment and signaling devices. The designated level for Firefighters' key operated switch is the Entry Level floor for Elevator 1, Basement Floor for Elevator 2.

### 2.2.2 Smoke Detectors

Smoke detectors are specified in Section 13851 INTERIOR FIRE DETECTION AND ALARM SYSTEM, ADDRESSABLE, including conduit and wiring from each detector to elevator machinery space control panel. Provide connections directly to elevator controls which will, when smoke is detected by any smoke detector, actuate Firefighters' Service and send each elevator to the correct floor as required by ASME A17.1. Provide dual-contact smoke detectors located in the elevator lobbies and the elevator machine room. Provide dual-contact smoke detector at top of hoistway. The circuit for elevator controller actuation of Firefighters' Service shall include only these smoke detectors. In lieu of dual-contact smoke detectors, an addressable fire alarm system with listed smoke detectors can be used in the above stated locations. Ensure that all smoke detectors are mounted on finished ceiling.

### 2.2.3 Fire Sprinklers

Provide fire sprinklers in accordance with Section 13930 WET PIPE SPRINKLER SYSTEM, FIRE PROTECTION; providing dual contact flow switch, check valve, and shutoff valve in each sprinkler line immediately outside of each machine room and hoistway. Provide electrical connection to fire sprinkler system in accordance with Section 13851 INTERIOR FIRE DETECTION AND ALARM SYSTEM, ADDRESSABLE. For each elevator, provide control wiring connecting the flow switch to the shunt trip equipped circuit breaker within the electrical panel serving the main line disconnect. Upon flow of water, flow switch shall instantaneously send a signal to cause opening of shunt-trip equipped mainline circuit breaker, in compliance with ASME A17.1, Section 2.8.2, and send a signal to fire alarm control panel to indicate water flow condition. Machine room sprinkler flow switch actuation shall shunt trip all elevator(s) served by the machine room. Hoistway sprinkler flow switch actuation shall shunt trip all elevator(s) in the hoistway.

### 2.2.4 Top-of-Car Operating Device

Provide operating device mounted on or from car crosshead, to permit operation of car at 0.75 mps maximum for adjustment, maintenance, testing, and repair. Include integral or remote safety device, continuous pressure "UP" and "DOWN" switches or buttons, emergency stop switch, and inspection switch.

### 2.2.5 Hoistway Access Switches

Provide key-operated hoistway access switch to permit limited movement of

car at terminal floors for car positioning, operative only when "INSPECTION" switch in car operating panel is in the "INSPECTION" position. Locate switch 1800 mm above floor level, within 300 mm of hoistway entrance frame or with only ferrule exposed when located in entrance frame.

#### 2.2.6 Independent Service

Provide exposed key-operated switch in car operating panel to enable independent service and simultaneously disable in-car signals and landing-call responses. Provide indicator lights that automatically illuminate during independent service.

#### 2.2.7 Elevator Operation

##### 2.2.7.1 Selective Collective Automatic Operation

Provide Selective Collective Automatic Operation. Provide illuminating push buttons.

#### 2.2.8 Parking Switch

Provide two-position parking switch in car station service cabinet. One position causes car to remain parked at floor landing where last used; other position causes car to park at Entry Level Floor, for Elevator 1 and Basement for Elevator 2.

### 2.3 ELEVATOR DRIVE SYSTEM

Provide hydraulic pump unit, piping, cylinder/plunger assembly, and rated equipment in accordance with ASME A17.1, which will operate at a maximum working pressure of less than 2756 kPag.

#### 2.3.1 Hydraulic Pump Unit

Provide self-contained unit including oil-hydraulic elevator pump, electric motor, drive assembly, oil strainer in suction line, structural steel outer base with tank and supports, oil-tight drip pan, and inner pump-mounting base. Limit acoustic output of elevator machine to 80 dbA. Provide sound-insulating panels to isolate airborne noise from non oil-immersed pump-motor assembly. Provide ventilation to cool hydraulic pump unit. Provide hydraulic cooler. Finish ferrous surfaces with rust-inhibiting paint.

##### 2.3.1.1 Tank Capacity

Provide tank capacity for full plunger displacement plus at least 38 liters.

#### 2.3.2 Hydraulic Controls and Equipment

Provide electrically operated "UP" valve, constant velocity "DOWN" valve, "UP" and "DOWN" leveling valves, "BYPASS UPON STARTING" valve, check valve, vacuum relief valve, automatic shutoff (rupture) valve, safety relief valve, manually operated lowering valve, and scavenger pump unit.

##### 2.3.2.1 Manual Shutoff Valves

Provide 1/4 turn ball valve rated at 2 MPa at elevator hydraulic pump suction inlet if pump is mounted outside the oil reservoir and the suction line exits the reservoir below the maximum oil level in the reservoir.

Provide 1/4 turn ball valve rated at 4 MPa at elevator pump discharge line in the machine room and in the oil supply line next to and on the pump side of the automatic shutoff valve in the pit.

#### 2.3.2.2 Manual Lowering Valve

Limit car descending speed under manual operation to 0.10 mps. Provide rigid plastic red tag for valve identification, inscribed "MANUAL LOWERING VALVE."

#### 2.3.2.3 Pump Discharge Strainer

Provide strainer in pump discharge to prevent foreign materials from entering control system and cylinder-plunger unit (jack).

#### 2.3.2.4 Muffler

Provide blowout-proof muffler, containing pulsation-absorbing materials in oil line between pump unit and jack.

#### 2.3.2.5 Pressure Switch

Where cylinders are installed with top of cylinder above top of oil reservoir, provide pressure switch in oil line between cylinder and electric lowering valve(s) to prevent operation of lowering valve(s) unless positive pressure exists at top of cylinder.

#### 2.3.2.6 Scavenger Pump Unit

Provide a scavenge oil reservoir, an electrically operated oil transfer pump, scavenge oil lines, a strainer, and pump controls. Connect the scavenge oil reservoir to the elevator cylinder between the plunger packing area and the plunger drip (wiper) ring, to capture the oil leaking by the plunger pressure packing. Provide a vacuum relief valve. Connect the scavenge oil pump suction to the scavenge oil reservoir and the strainer, and the discharge to the elevator oil reservoir. Provide a scavenge oil reservoir level switch to control the scavenge oil pump. Scavenger pump shall operate independently of elevator hydraulic fluid pressure. Provide a manual-reset pit flood switch to prevent pump operation if pit is flooded. Anchor pump and oil reservoir to the pit floor.

#### 2.3.2.7 Piping and Accessories

Provide ASTM A 53/A 53M or ASTM A 106, Schedule 80, black steel piping with ASME B16.9 and ASME B16.11 fittings. Schedule 80 piping shall extend from the pump control valve body, inside the pump unit, to the hydraulic cylinder in the hoistway. Provide dielectric union at each end of the "pump to cylinder" oil supply line. Provide hangers or supports for all piping. Provide welded or threaded forged pipe fittings that are located between the shut off valve and the cylinder inlet.

#### 2.3.2.8 Low Oil Condition

Provide device for each elevator to protect pumping equipment in event oil level is too low. When device operates, it shall stop pump and motor and cause car to descend to lowest landing, open car doors and cease elevator operation except for door control circuits. Provide illuminating indicator on machine room control panel to alert upon a low oil condition.

#### 2.3.2.9 Oil Characteristics

- a. Viscosity, Saybolt Universal Seconds 145 to 160 at 38 degrees C.
- b. Viscosity, Saybolt Universal Seconds 42 to 44 at 99 degrees C.
- c. Pour Point, ASTM D 97, -26 degrees C maximum.
- d. American Petroleum Institute (API) Gravity 29 to 33 at 15 degrees C.
- e. Flash Point, ASTM D 92, 190 degrees C minimum.

#### 2.3.2.10 Oil Temperature Device

Provide means to maintain oil temperature between 15 and 38 degrees C regardless of ambient temperature.

#### 2.3.3 Cylinder-Plunger Unit

Provide plunger type hydraulic elevators. Provide plungers of single-piece seamless steel construction. Provide stop plate or ring welded to bottom of the plunger. Provide packing and wiper (drip) ring with outlet for connection to the scavenge oil reservoir to collect leakage oil from cylinder for either inspecting for contamination or returning to tank. Use only standard packing glands with bolts that compress packing. Provide threaded 6 mm bleeder valve at top of cylinder just below packing gland. Telescopic cylinder-plunger units are not acceptable.

#### 2.3.4 Cylinder Protection

Protect the cylinder with a pipe-manufacturer applied "Applied Extruded Coating." The AEC coating application process shall include the following steps as a minimum: blast clean the bare pipe exterior surfaces to white metal, apply a minimum of 0.25 mm undercoating of heated butyl rubber adhesive; and apply a minimum of one mm thickness overcoating of polyethylene, hot extruded over the undercoating. The overcoating shall be free of surface blemishes, cracks, voids, and contamination from foreign substances. Field pipe joints and coating repairs shall be field applied coatings covered with heat-shrinkable pipe sleeves, following the cylinder manufacturer's instructions. Protect the AEC coating from damage until the cylinder is set into the cylinder well, plumbed, and aligned.

#### 2.3.5 Automatic Shutoff Valve

Provide automatic shut-off valve in oil supply line as close to cylinder inlet as possible. Provide threaded pipe connections to the valve. When there is ten percent drop in NO-LOAD operating pressure, automatic shut-off valve shall be activated. When activated, device shall immediately stop descent of elevator and hold elevator until lowered by use of manual lowering feature of valve. Arrange manual lowering feature of automatic shut-off valve to limit descending speed of elevator to 0.10 mps. Exposed adjustments of automatic shut-off valve shall have means of adjustment sealed by certified elevator inspector after being set to correct position and tested in accordance with Paragraph Automatic Shutoff Valve Tests.

#### 2.3.6 Cylinder Well System

The cylinder well system shall consist of a well casing and a liner.

#### 2.3.6.1 Well Casing

Drill well for hydraulic cylinder, providing adequate depth, as indicated. Line well with steel casing with minimum wall thickness of 6 mm, and minimum inside diameter of not less than 125 mm larger than PVC liner maximum outside diameter, including cap and couplings. Close bottom of well casing with steel plate at least twice as thick as casing wall thickness, welded continuously all around, prior to insertion into well, or close well casing bottom by plugging with minimum of 150 mm of concrete, embedding casing bottom at least 50 mm but not more than 100 mm into the wet concrete. Install cylinder well casing not more than 25 mm out of plumb over entire length. Backfill the well outside of the casing with fine, dry, salt-free sand, as required to maintain casing straight and plumb, or backfill with bentonite grout if more than one water-bearing strata are penetrated by well. Maintain well casing pumped dry throughout remaining installation of elevator.

#### 2.3.6.2 PVC Liner

Provide Schedule 80 PVC pipe liner with bottom cap and couplings; joints sealed watertight using PVC pipe manufacturer's recommended adhesive or heat welding methods. Liner inside diameter not less than 76 mm larger than elevator cylinder maximum outside diameter. Set PVC liner into well casing, centered and plumb. Securely locate PVC liner bottom end within well casing with fine, dry, salt free sand.

#### 2.3.6.3 Pressure Test

Install pressure test cap onto PVC liner, equipped with at least: safety relief valve set to relieve at 205 kPag; 114 mm diameter dial pressure gage scaled for 0 to 690 kPag and calibrated to 0.5 percent accuracy; and an air pressure admission throttling and shutoff valve. Perform air pressure test by slowly admitting dry compressed air to pressurize PVC liner to 205 kPag.

Shut off air supply at throttle/shutoff valve, disconnect compressed air source, observe and record air pressure in PVC liner every 5 minutes for not less than 30 minutes. Liner shall not allow drop in air pressure in excess of one kPag over the 30 minute test period. Perform test in presence of the Elevator Inspector. Upon satisfactory completion of pressure test, remove test cap and dry interior of PVC liner. Upon failure of test, remove, repair, reinstall, and retest PVC liner until satisfactory. For safety, pressure test shall only be performed when liner is fully inserted in the well casing and well.

#### 2.3.6.4 Cylinder Installation

Remove surface moisture from inside of liner by wiping with dry cloth or purging with warm dry air prior to installing elevator cylinder. Install cylinder. Provide elevator manufacturer's recommended supports under cylinder head and attach cylinder head supports to cylinder and pit support channels in accordance with elevator manufacturer's instructions. Set cylinder into the pit. Plumb cylinder using "Spider-Bob" method.

#### 2.3.6.5 Casing Fill

Following cylinder installation, fill the space between PVC liner and steel casing with fine, dry, salt-free sand in 610 mm lifts with tamping between each lift. Continue filling with sand up to the level at the pit floor



seal.

#### 2.3.6.6 Liner Inspection and Test Tube

Provide a 19 mm PVC test tube with strainer located within 152 mm of bottom of liner. Strainer shall exclude sand and admit air, water or oil. Provide top of test tube with removable cap to exclude foreign matter.

#### 2.3.6.7 Cylinder Bottom Location Fill

At the option of the contractor, clean dry sand may be used up to and not more than 610 mm above the bottom of the cylinder, to stabilize the cylinder. Remainder of the liner shall be empty.

#### 2.3.6.8 Seal

Seal gap between cylinder and PVC liner and gap between liner and well casing with foam insert strong enough to retain and support final grouting. Provide 21 MPa grout to a minimum of 102 mm thickness and level top of final grouting with pit floor.

#### 2.3.6.9 Containment

Protect exposed portions of hydraulic elevator oil supply line that are installed below ground, including portions encapsulated in concrete, or covered by construction, with continuous Schedule 80 PVC containment system, extending from machine room to elevator cylinder head connection. Coat and wrap line similar to elevator cylinder. Cap and seal containment system annular space.

#### 2.3.7 Motors

Provide NEMA MG 1 induction motors with squirrel cage, motors with drip-proof enclosure, continuous rated, maximum 1800 rpm, and Class F insulation rated at 120 starts per hour.

##### 2.3.7.1 Insulation Resistance and Motor Nameplate Data

Provide minimum of one megohm insulation resistance between conductors and motor frame. Provide motor nameplate listing rated wattage (horsepower), speed, and ampere, permanently mounted in position visible to viewer without use of special tools, such as a mirror. Provide motor and pump data on the outside of machine frame.

##### 2.3.7.2 Maximum Allowable Motor Amperage

When motor is running and elevator is lifting rated load at rated speed, motor shall not exceed its own nameplate amperage. Provide wye-delta starters.

#### 2.4 CONTROL EQUIPMENT

NFPA 70 and ASME A17.1, Section 3.26. Provide elevator motor controller of magnetic reduced-voltage resistance or wye-delta start with overload relays in each line and reverse phase relay. Provide controls for starting, stopping, and speed of elevator and to give specified operation. Enclose control equipment in factory-primed and baked-enamel coated sheet-metal cabinets with removable or hinged doors and ventilation louvers.

#### 2.4.1 Logic Control

Provide solid-state microprocessor controller to enable programmable control of call allocation, logic functions, door control, speed sensing and car position. Provide a method of reprogramming adjustable parameters of computerized controls. Store all programming in non-volatile memory. The microprocessor control system is acceptable only if hardware and software required to maintain and utilize microprocessor is provided and training is provided to Government Personnel by the equipment manufacturer and supplier. For the repair of microprocessor control system, provide maintenance tools, supporting computer software, and software documentation required for complete maintenance of elevator system including diagnostics and adjustments. Tools may be hand held or built into control system. Provide tools which do not require recharging to maintain their memory or authorization for use. Do not use software which requires periodic reprogramming, or reauthorization. Programs shall be stored in non-volatile memory. Tools and software may be factory programmed to operate only with this project's identification serial number.

#### 2.4.2 Self-Leveling and Anti-Creep Device

Provide each elevator with two-way, automatic self-leveling device that brings car floor to within 6 mm of level with floor landing regardless of load, position of hoistway door, or direction of travel.

### 2.5 OPERATING PANELS, SIGNAL FIXTURES, AND COMMUNICATIONS CABINETS

#### 2.5.1 Capacity and Data Plates

Attach faceplates with spanner security screws. On car panel, provide stainless steel capacity and data plates, with name of elevator manufacturer.

#### 2.5.2 Car and Hall Buttons

Provide recessed tamper-proof push buttons of minimum 20 mm size satin-finish stainless steel, with illuminating jewel center.

#### 2.5.3 Hall Station Door Operating Buttons

Identical in size and design to hall call buttons, but not illuminating.

#### 2.5.4 Passenger Car-Operating Panel

Provide each car with one car operating panel that contains operation controls and communication devices. Provide exposed, flush mounted buttons for the controls that must be passenger accessible. Provide service cabinet or keyed switches for those switches that should not be passenger accessible. Allow maximum 1200 mm between car floor and center line of top operating buttons. Allow 900 mm between car floor and center line of bottom button. Use engraving and backfilling or photo etching for button and switch designations. Do not use attached signs.

### 2.6 PASSENGER CONTROLS

#### 2.6.1 Passenger Car-Operating Panel

- a. Illuminating operating call buttons identified to correspond to landings served by elevator car.

- b. "DOOR OPEN" and "DOOR CLOSE" buttons.
- c. Keyed "STOP" switch in accordance with ASME A17.1, rule 2.26.2.
- d. "ALARM" button in compliance with UFAS, ADA, and ASME A17.1, Rule 2.27.1. Alarm button shall be red with engraved legend "ALARM." Alarm button shall illuminate when pushed. Locate "ALARM" button at panel bottom.
- e. "FIRE DEPARTMENT" key switch, with "OFF-HOLD-ON" positions, in that order with key to be removable in all positions. Provide fire sign or jewel, and audible signal device, in accordance with ASME A17.1 Section 2.27.3. Both visual and audible signals are activated when Phase I key switch in hall is activated or when smoke detector activates return of elevator(s) to main fire response floor. Visual and audible signal shall remain activated until car has reached main or designated alternate fire response floor. Upon arrival at fire response floor visual signal remains illuminated and audible signal becomes silent.
- f. Emergency two-way communication. Provide momentary pressure, single illuminating pushbutton operated communication device that complies with ASME A17.1, UFAS, and the Americans with Disabilities Act.

#### 2.6.1.1 Service Controls

- a. Inspection switch that transfers car control to top-of-car inspection operating controls and prevents car operation from in-car control panel.
- b. Independent service switch.
- c. Two car light switches, one for light in car and one for lights on top and bottom of car frame.
- d. Fan switch, two-speed.
- e. 120-volt ac 60 Hz single-phase duplex electrical outlet of ground-fault-circuit-interrupt (GFCI) design.
- f. Device for communication between car and elevator machine room.
- g. Parking switch.

#### 2.6.1.2 Certificate Window

Provide 100 mm high by 150 mm wide certificate window in car operating panel for elevator inspection certificate.

#### 2.6.2 Switches and Devices

Provide elevator manufacturer's standard grade for switches and devices on car operating panel. Legibly and indelibly identify each device and its operating positions. Locate car dispatching buttons in identical positions in car operating panels for corresponding floors.

#### 2.6.3 In-Car Position and Direction Indicator and Signal

In-car direction indicator shall be included in the in-car position indicator fixture.

#### 2.6.3.1 In-Car Position Indicator and Signal

Provide horizontal electrical or electronic digital position indicator located minimum of 2135 mm above car floor. Arrange indicator to show floor position of car in hoistway and its traveling direction. Indicate position by illuminating of numeral or letter corresponding to landing at which car is passing or stopping. Provide audible signal to alert passenger that elevator is passing or stopping at a floor. Provide audible signals exceeding ambient noise level by at least 20 dbA with frequency not higher than 1500 Hz.

#### 2.6.3.2 In-Car Direction Indicator and Signal

Provide visual and audible car direction indicators in car, indicating car traveling direction. For visual directional signal, provide arrow of minimum 65 mm in size. Use equilateral triangles for arrows, green for upward direction and red for downward direction. Provide audible signal that sounds once for upward direction and twice for downward direction.

#### 2.6.4 Landing Position and Direction Indicator and Signal

Provide a single fixture containing the landing position and direction indicator.

##### 2.6.4.1 Landing Position Indicator and Signal

Provide an electrical or electronic digital position indicator similar to the car position indicator. Arrange position indicator in wall horizontally above the door frame or vertically at the side of the door frame. Indicators to show floor position of car in hoistway. Indicate position by illumination of numeral or letter corresponding to landing at which car is passing or stopping.

##### 2.6.4.2 Landing Direction Indicator and Signal

Provide landing direction indicator with visual and audible signal devices. Provide single direction indicator at terminal floors; "UP" and "DOWN" direction indicator at intermediate floors. Provide equilateral triangles not less than 65 mm in size, green for upward direction and red for downward direction. Provide electronic audible device that sounds once for upward direction and twice for downward direction. Provide audible signals exceeding ambient noise level by at least 20 decibels with frequency not higher than 1500 Hz.

### 2.7 HOISTWAY AND CAR EQUIPMENT

#### 2.7.1 Guide Rails and Fastenings

Paint rail shanks with one coat black enamel. Only T-section type rail is acceptable.

#### 2.7.2 Car Buffers

Provide buffer data plate on each buffer.

### 2.7.3 Pit Equipment

#### 2.7.3.1 Pit "STOP" Switch

Provide push/pull type pit "STOP" switch for stopping elevator motor, independent of regular operating device. Locate on same side of hoistway as ladder.

#### 2.7.3.2 Ladders

Specified in Section 05500 MISCELLANEOUS METALS.

#### 2.7.3.3 Lighting of Pits

Locate pit light not less than 1800 mm above pit floor. Locate switch on same side of hoistway as ladder. Provide GFCI duplex receptacle in each pit.

### 2.8 TERMINAL STOPPING DEVICES

Provide each elevator with a terminal stopping device.

#### 2.8.1 Wiring and Traveling Cables

NFPA 70, Article 620 and Section 16415 ELECTRICAL WORK, INTERIOR. Suspend traveling cables by means of self-tightening webbed devices.

#### 2.8.2 Emergency Signaling Device

Provide audible signaling device, operable from Car Operating Panel button marked "ALARM". The audible signaling device shall be mounted in hoistway.

### 2.9 PASSENGER CAR AND HOISTWAY DOOR ACCESSORIES

ASME A17.1, Sections 2.12, 2.13, 2.14, and 3. Provide infra-red curtain unit. Provide high-speed electric operator, safety interlocks for car and hoistway doors, and electric safety contact to prevent car operation unless doors are closed.

#### 2.9.1 Infra-red Curtain Unit

Provide Infra-red Curtain Unit (ICU) with multiple infra-red beams that protect to the full height of the door opening. Minimum coverage shall extend from 50 mm off the floor to 1778 mm above floor level. Door operation must meet the requirements of ASME A17.1 Rule 2.27.1 and 2.13.5.

### 2.10 PASSENGER ELEVATOR GUIDES, FRAME, PLATFORM, AND ENCLOSURE

#### 2.10.1 Roller Guides

Provide roller guide assemblies in adjustable mountings on each side of car in accurate alignment at top and bottom of car frame.

#### 2.10.2 Car Ventilation and Accessories

Provide natural and forced ventilation, stainless steel hooks, with fire retardant pads.

#### 2.10.2.1 Car Shell, Return Panels, Entrance Columns, Cove Base, and Transom

Provide 14 gauge minimum non perforated steel. Apply sound-deadening mastic on all exterior components.

#### 2.10.2.2 Car Top

Provide reinforced 12 gauge minimum steel with hinged emergency exit openable by hand from car top only. Provide electrical contact which prevents operation of elevator when emergency exit is open. Provide sound-deadening mastic on all exterior components.

#### 2.10.2.3 Car Door

Provide 16 gauge minimum steel, sandwich construction without binder angles. Provide a minimum of 2 door guide assemblies per door panel, one guide at leading and one at trailing door edge with guides in the sill groove their entire length of travel.

#### 2.10.2.4 Car Entrance Sill

Provide one piece extruded aluminum entrance sill. Set sills level and flush with floor finish. Use same material for hoistway and car entrance sills.

#### 2.10.2.5 Carpet

Unless otherwise specified, the elevator shall be carpeted.

### 2.11 PASSENGER ELEVATOR HOISTWAY DOORS AND ENTRANCES

Provide hoistway entrance assemblies which have a minimum 1-1/2 hour fire rating.

#### 2.11.1 Hoistway Entrance Frames

Frame of 1.8 mm (14 gauge) thick stainless steel. Solidly grout uprights of entrances to height of 1500 mm.

#### 2.11.2 Hoistway Entrance Sills

Provide one-piece extruded aluminum entrance sills. After sill is set level and flush with finished floor height, solidly grout under full length of sill. Use same material for hoistway and car door sills.

#### 2.11.3 Hoistway Entrance Doors

Provide hoistway entrance door constructed with hollow metal non-vision construction with flush surfaces on car and landing sides. Provide a minimum of 2 door guide assemblies per door panel, one guide at leading edge and one at trailing door edge with guides in the sill groove the entire length of travel.

#### 2.11.4 Entrance Fascias and Dust Covers

Provide sheet metal hoistway door track dust covers at each landing. Dust covers must cover door locks and door roller tracks and extend the full width of the door track and associated hardware.

### 2.11.5 Hoistway Ventilation

Provide hoistway ventilation directly to outside air by fixed louver through side wall of hoistway at top of hoistway. Net size of the louver shall be at least 3.5 percent of cross section of hoistway.

### 2.12 HANDICAPPED ACCESS

#### 2.12.1 Provision For Handicapped

36 CFR 1191, Sections 4.10 for Elevators, 4.30 for Signage, and 4.31 for Telephones.

### 2.13 EMERGENCY POWER OPERATION

Upon outage of normal power and initiation of emergency power, provide circuitry and wiring to operate elevator telephone to accomplish operation sequences.

## PART 3 EXECUTION

### 3.1 INSTALLATION

Install in accordance with manufacturer's instructions, ASME A17.1, 36 CFR 1191, and NFPA 70.

#### 3.1.1 Traveling Cables

Do not allow abrupt bending of traveling cables.

#### 3.1.2 Automatic Shutoff Valve

Locate in supply-return line, as close as possible to cylinder-plunger unit.

#### 3.1.3 Structural Members

Do not cut or alter. Restore any damaged or defaced work to original condition.

#### 3.1.4 Safety Guards

Selector cables or tapes exposed to possibility of accidental contact in machine room shall be completely enclosed with 1.5 mm thick sheet metal or expanded metal guards, both horizontally and vertically. Exposed gears, sprockets, and selector drums shall be guarded from accidental contact in accordance with ASME A17.1.

#### 3.1.5 Miscellaneous Requirements

Include recesses, cutouts, slots, holes, patching, grouting, and refinishing to accommodate elevator installation. Use core drilling to drill all new holes in concrete. Finish work to be straight, level, and plumb. During installation, protect machinery and equipment from dirt, water, or mechanical damage. At completion, clean all work, and spot paint.

#### 3.1.6 Firefighters' Service

Firefighters' service shall be complete including installation and wiring of all smoke detectors in accordance with ASME A17.1, Section 2.27.3.2.

Coordinate smoke detector installation for firefighters' service.

### 3.2 FIELD QUALITY CONTROL

After completing elevators system installation, notify Contracting Officer that elevator system is ready for final inspection and acceptance test. Contractor shall perform all required tests and demonstrate proper operation of each elevator system and prove that each system complies with contract requirements and ASME A17.1, including Section 8.10.3, "Acceptance Inspection and Tests of Passenger and Freight Hydraulic Elevators", and the applicable requirements of Section 8.3, "Engineering and Type Tests". Inspection procedures in ASME A17.2.2 form a part of this inspection and acceptance testing. All testing and inspections shall be conducted in the presence of both the Elevator Specialist and the Elevator Inspector. Demonstrate the proper operation of all equipment at various date settings, selected by the Elevator Inspector, ranging from the date of contract award through 1 January 2099. The Elevator Inspector shall complete, sign and post the results of all tests and inspection results after successful completion of inspection and testing. The Contractor is responsible for all costs involved with reinspection and retesting required to correct discrepancies discovered during testing and the subsequent retesting required, including all costs and expenses incurred by the Government Furnished Inspector.

#### 3.2.1 Testing Materials and Instruments

Furnish testing materials and instruments required for final inspection. Include calibrated test weights, tachometer, 600-volt megohm meter, volt meter and ammeter, three Celsius calibrated thermometers, door pressure gage, spirit level, stop watch, hydraulic pressure test gauge, and a 30 meter tape measure.

#### 3.2.2 Field Tests

The Contractor shall submit Field Tests Reports after completing each of the specified tests, as required in the Submittals paragraph.

##### 3.2.2.1 Endurance Tests

Test each elevator for a period of one hour continuous run, with specified rated load in the car. Restart the one hour test period from beginning, following any shutdown or failure. During the test run, stop car at each floor in both directions of travel for standing period of 10 seconds per floor. The requirements for Rated Speed, Leveling, Temperature Rise, and Motor Amperes testing specified herein shall be met throughout the duration of the Endurance test.

##### 3.2.2.2 Automatic Shutoff Valve Tests

Test the automatic shutoff valve twice. Once at beginning of acceptance test and again at conclusion of one-hour Endurance test to ensure consistent performance of shutoff valve, regardless of temperature of equipment and oil.

##### 3.2.2.3 Speed Tests

Determine actual speed of each elevator in both directions with rated load and with no load in elevator car. Make Speed tests before and immediately after Endurance test. Determine speed by tachometer reading, excluding



accelerating and slow-down zones per ASME A17.2.2, Section 2.22.4. Minimum acceptable speed is the Rated Speed as specified. Maximum acceptable elevator speed is 110 percent of Rated Speed.

#### 3.2.2.4 Leveling Tests

Test elevator car leveling devices for landing accuracy of plus or minus 6 mm at each floor with no load in car, symmetrical load in car, and with rated load in car in both directions of travel. Determine accuracy of floor landing both before and immediately after endurance tests.

#### 3.2.2.5 Pressure Tests

Check operating pressure at pump and cylinder head under no load and rated load. Test pressure at which relief valve operates.

#### 3.2.2.6 Insulation Resistance Tests

Perform tests to ensure wiring systems free from short circuits and grounds. Minimum acceptable insulation resistance for electrical conductors is one megohm between each conductor and ground and between each conductor and other conductors. Prior to megohm meter test, make provision to prevent damage to the electronic devices.

#### 3.2.2.7 Temperature Rise Tests

Determine the temperature rise of the hydraulic pump motor during the full load test run for a minimum of one hour. Under these conditions, maximum acceptable temperature rise shall not exceed the acceptable temperature rise indicated on the manufacturer's data plate. Start test only when equipment is within 5 degrees C of ambient temperature.

#### 3.2.2.8 Motor Ampere Tests

Measure and record motor amperage when motor is running and elevator is lifting at rated load and speed. Measure and record motor amperage at the beginning and the end of Endurance test.

### 3.3 OPERATION AND MAINTENANCE TRAINING

The Elevator Specialist shall instruct Government personnel in care, adjustment, and maintenance of elevator equipment for a period of not less than 5 working days immediately following acceptance of system. The Contractor shall submit Operation and Maintenance Manuals as required in the Submittals paragraph.

-- End of Section --

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